# The Electrical World.

VOL. XXXII. NEW YORK, SEPTEMBER 10, 1898. No. 11.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

*SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,*

In the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, SEPTEMBER 10, 1898. NO. 11.

CONTENTS.

| | PAGE. |
|---|---|
| Editorial | 253 |
| The Feeding of the New York & Sea Beach Railway | 255 |
| Overhead Switches on the Brooklyn Bridge | 255 |
| Electric Traction Between Buffalo and Lockport | 256 |
| The Largest Induction Motor in America | 258 |
| Temporary Power Stations of the Metropolitan Street Railway Company | 258 |
| Undeveloped Water Power of the Little River, North Carolina, by Prof. A. F. McKissick | 261 |
| An English Street Railway System with Multiphase Distribution | 262 |
| The Welsbach Filament | 263 |
| The Overhead Trolley in England | 264 |
| Electricity in the United States Capitol, by B. C. Washington | 265 |
| Digest of Current Electrical Literature, Compiled by Carl Hering | 268 |
| Book Reviews | 271 |
| The "M" Receiver | 271 |
| Two of the Exhibits at the Omaha Exposition | 271 |
| Ball Bearing Boiler-Tube Cleaner | 272 |
| A New Railway Motor | 272 |
| Magnetic Blow-out Automatic Circuit Breakers | 273 |
| A New Primo-Secondary Battery | 274 |
| India Mica | 274 |
| Portable X-Ray Outfit on the Hospital Ship "Solace" | 274 |
| Departments: | |
| Financial Intelligence | 275 |
| Special Correspondence | 275 |
| General News | 276 |
| Personal Note | 278 |
| Trade and Industrial Notes | 278 |
| Business Notice | 279 |
| Illustrated Record of Electrical Patents | 279 |

## ELEVATED RAILROADS AND GEARS.

The elevated railroads of this country have largely changed over of late to electric traction or made preparations for such change. One of the chief advantages to the public often pointed out in this connection is the reduction of the noise due to the elimination of the cylinder exhaust. A close comparison between the elevated roads now running in New York City by steam power and in Chicago by electric power shows that this advantage of the electric is nullified, or even more than nullified, by another source of noise, namely, the gears. Noise from this source has been pretty well eliminated from surface equipments, but the conditions on an elevated structure are entirely different. The structure itself forms a huge resonator which responds at once to any vibrations in parts as intimately connected with it as are the trucks running upon its roadbed. The electrically operated trucks seem also to pound much more seriously over frogs and crossings than do trailer trucks or even steam locomotives. This may be due to the greater amount of dead weight not supported by springs in the electrical equipment.

---

It is to be hoped that the manufacturers of traction motors may see their way clear to the construction of gearless motors for this service. Such motors have been tried and found unsuitable for surface traction, largely on account of the comparatively low speed of the car wheels and consequently high gear ratio needed to obtain a peripheral velocity at the air gap sufficient for proper motor output without too great a weight of motor. As the car speed increases, however, the gear ratio can come down proportionately with the same armature speed. With suburban and elevated service the speeds are considerably higher than can be maintained on public highways, and sufficiently so for a gear ratio approximately one to one.

---

The gearless motor is not, however, as easy to design as a geared motor with a ratio of one to one, for the reason that with the gearing the motor centre can be raised above the wheel centre and with the same clearance between the motor shell and track considerably more room can be obtained for armature and field magnets. When the motor is mounted directly upon the wheel axle the parts are very much cramped, and particularly is this the case if the wheels are small. The larger the wheels the greater is the capacity of the motor that can be mounted direct and the greater the ratio of the speed at the armature periphery to the speed of the car or train, giving a double increment of the power of the motor. Large wheels mean high trucks, and much higher trucks than now used in elevated service would necessitate some modification in the construction of the cars. Some English roads using gearless motors, notably the London underground lines, construct the car floors higher at the ends over the trucks than throughout the rest of the car, sufficient head room being left, however, over these raised portions of the floor for seats for passengers, the cars themselves being entered through side doors instead of at end platforms. Such a disposition as this gives an opportunity for a ready enlargement of the wheels by a considerable extent. Even so, however, it is difficult to get in a truck as much power as can be obtained with gearing, but plenty of power can be installed under the car for its own propulsion and by means of a multiple unit system trains can be readily propelled.

### THE SUCCESS OF THE OPEN CONDUIT IN NEW YORK CITY.

About one year ago the Metropolitan Street Railway Company started the active construction work of a complete open conduit electric traction system to be extended eventually over all of its routes. Rather than delay the operation of the lines electrically until a power generating and distributing system of the enormous magnitude necessary for driving such a load could be constructed, the company installed two temporary power stations, the interesting points of which will be found on other pages of this issue. The apparatus in these temporary stations, aggregating a generating capacity of almost 10,000 horse-power, will only be in service about a year and then discarded, and its place occupied by rotary converters taking power from the high-tension alternating system. The temporary equipment is of the most thorough and reliable type, no cheap work being allowed even in this case where, if anywhere, economy of first cost might be considered advisable. The most interesting feature of it all is that the company should see fit to install such an expensive equipment, against a large part of which depreciation of 100 per cent. must be charged and a very large percentage even on what can be sold, its only return being the increased business for one year over that obtained with the former equipment of horse-power, and to a certain extent the good will of the public.

---

The increased business due to the improved nature of the service has been most astonishing in its magnitude, even to the officials of the company themselves, although they have had previous experience in the re-equipment of horse car lines with cable apparatus. Where small horse cars jogged along with a fair patronage, double-truck electric cars of twice the capacity, twice the speed and one-third the headway are crowded to their very limit. The company has met the public's demands by constantly adding to the service, putting on cars as fast as they could be built and equipped and loading up every new generator to its limit as soon as it was ready to run. The improvement in service is so great that the public has insistently demanded the change on other lines and two such lines reaching the shopping districts are now about ready to go into service. The mammoth units of the permanent power station will not be ready for service in time to carry the heaviest winter load and two 850-kw generators are now being hastily erected in a temporary location to help the temporary stations, but even with them it is apparent that little electrical car heating can be done during the rush hours of the winter and the generating stations are going to be pretty well overloaded from dawn till midnight. The traffic has largely come, of course, from the Manhattan elevated, the accessibility of the surface lines, the extensive transfer privileges and the perfection of the service generally taking from the overhead system practically all of the short-haul business, leaving it only the long-distance traffic, in which its higher speed is of greater value.

---

Mchanically and electrically the conduit system on these lines has been proven an unqualified success. Troubles with the plows and underground rails are much less frequent than with the overhead pole and trolley wire. The nuisance of the trolley slipping off has no equivalent disadvantage in the underground system, the plow of which requires no attention whatever on the road. It must be confessed, however, that when accidents do occur to conduit apparatus they are likely to be more disastrous than cases of trouble with the overhead trolley. If the latter becomes deranged or broken it is readily pulled down and the car pushed or pulled in by another, but accidents to the plow of the underground system are likely to choke up the conduit or wedge parts tightly in the slot and to require considerable work to clear the line again for operation. No trouble has been experienced from water or snow and apparently but little trouble from spreading of the conductor rails or failure to make contact from any cause. An incidental advantage of the conduit system of no little importance is the solidity of the roadbed, due to the depth and massive nature of the concrete conduit walls, which with the yokes form a most perfect foundation for the track. A feature of the switches and crossings from which some trouble might have been anticipated is the necessary break in the continuity of the conductors, cutting off power from the car for short distances at these points. To be sure this is somewhat of a nuisance at night to passengers who are reading; as the lights go out with annoying frequency on a complicated crossing. The attention of the motorman is also distracted to a certain extent from his other cares at these points by the necessity of turning off the power before his plow reaches each such break and turning it on immediately after leaving the break, and of preventing his car from stopping in the open circuit position, in which case it could not again be started. This requirement, however, seems to give no trouble in practice.

---

### COMBINED STREET AND PRIVATE RIGHT OF WAY TRACTION.

One of the most notable features of the instances in which electric power has been up to the present adopted for traction purposes on private rights of way is the fact that through service is, as a rule, given from the streets either at one or the other terminal or both, the same cars running on the public highways and the private right of way. This is notably the case in two such installations described in other columns of this paper, one operating between Buffalo and Lockport, N. Y., and the other between Brooklyn and the seashore. In both instances the existing street railway systems serve as a distributing network, over which the cars spread to various destinations after leaving the high speed through line.

---

In general it may be stated that in all interurban traffic but a small percentage of the passengers comes from the immediate neighborhood of any one terminal station, and the ideal service is one that will give a passenger an opportunity to ride without a change of cars from the street corner nearest to his point of departure to the street corner nearest his destination in the other city. The majority of the run should be covered at high speed, and if so the slow speed incident to the terminal collection and distribution of passengers is not a serious objection. Steam railroads are unfitted for this service owing to the impossibility of manipulating their rolling stock through the public streets, and street railway systems other than electric are also unfitted owing to their inability to operate economically and satisfactorily over private rights of way. The electric service combining street-railway lines as sort of terminal feeders and the routes over private right of way as intermediate express trunk lines approaches most nearly to this ideal desideratum.

---

### CIRCUIT BREAKERS VERSUS FUSES.

It is becoming customary to use circuit breakers instead of switches to open and close main circuits, this probably being due to the fact that it is easier to trip the trigger of a circuit breaker than to pull out a heavy switch. This practice, although prompted by laziness, is to be commended, as the carbon brake of the circuit breaker removes the arc from the main contacts to a point where it does no harm. Double pole circuit breakers, made up in such a way that the two sides can be independently closed, require no switches in series with them, since the first pole restored acts as a safety when the second is closed, unless double-throw or change-over connections have to be made in the circuit. Even in this case the circuit breaker can always be opened in ahead of the switch, eliminating the arc from the switch contacts. It might be well for the manufacturers of this type of apparatus to get up double-throw, single, double or triple pole circuit breakers, which could be used in place of the present circuit breakers and switches.

### The Feeding of the New York & Sea Beach Railway.

One of the most popular routes to Coney Island is a road which has been in service a great many years, with trains drawn by steam locomotives, and known as the New York & Sea Beach Railway. The road is 6 miles in length, starting from the water front near Sixty-fifth Street, Brooklyn. Last winter the Brooklyn Heights Railroad Company obtained control of this road and decided to equip it electrically and give a through service over its street lines and the Sea Beach route to the island. The problem of feeding currents for this road was a rather difficult one, and was rendered more so by the necessary haste in the construction of the apparatus. The nearest station of the Brooklyn Heights system was the Southern Station, situated at the foot of Fifty-second Street, Brooklyn, and equipped with twelve four-pole generators belted in pairs to Corliss engines. It was proposed at first to supply the new line and one other long route to the seashore by means of a high-tension multiphase and rotary system, and complete designs were worked out with this end in view. The poles even were erected for carrying the overhead high-tension lines. The scheme contemplated the use of the alternating system for supplying another load in winter, the sub-station apparatus to be made portable for this purpose; but the plan had to be abandoned for two reasons—one, the inability to obtain franchises for the transmission line, and the other the difficulty in obtaining the equipment in the short time allowable, since such apparatus is not as yet thoroughly standardized, and the manufacturing companies are not able to give prompt deliveries. The booster system was then adopted as the only alternative, and the method of connecting up the lines, feeders and boosters constitutes rather a novelty in electric railway practice.

It was anticipated that the traffic would be limited only by the capacity of the line, the service to be rendered by twelve-bench open double-truck cars, weighing about 10 tons each, running at about 30 miles per hour, and operated without trailers, with a minimum headway of 20 seconds. It was calculated that this would call for a maximum load of about 2200 amperes. The closeness with which such estimates can be made is well illustrated in this case by the fact that the loads at the maximum periods vary from 2000 to 2300 amperes. Three hundred and fifty cars are in service over this route, the cars leaving the private right of way at the Brooklyn end and spreading to various terminals, such as the New York end of the bridge, various ferries, etc. The headway has reached a minimum of 14 seconds, but without dangerous overcrowding, owing to the nature of the road and its consequent absence of interference from other traffic.

The two trolley wires of 00 cross-section are continued through from one end of the line to the other without a break, and are reinforced by what is known as a "side feeder" of 0000 cross-section, tapped into them at various points, this 0000 line being more properly called—in conformity with the terminology of lighting systems—a main than a feeder. Its purpose in conjunction with the trolley wires is to distribute any local load over the various feeders proper, which are tapped into the line at several points. For the two miles of the line nearest the station the size of the so-called "side feeder" is increased to 500,000 cm, and it becomes a feeder connected directly with the station bus bars and supplying some 300 amperes from the latter. The rest of the line is supplied by means of one 0000 and three 500,000-cm feeders tapped into the "side feeders" and trolley lines at four points. At times of light loads all these feeders are directly connected with the station bus bars, on which the voltage rises to about 580 volts above ground, but on Sundays, holidays and other times of especially heavy loads two special engine-driven boosters are started in the station, the two shorter feeders being fed through one of these boosters and the two longer feeders through the other. Economy of power is of little importance in this service, owing to the short duration of the heavy loads during the year, and hence the feeders were proportioned, not to keep the drop within any predetermined limit, but only of sufficient size to safely carry the currents which it was estimated would be thrown upon them. The boosters, then, were specified of sufficient voltage to overcome the feeder drop with this maximum current, the one requirement of the whole system being the maintenance of 500 volts at all points on the line for speed considerations. The two boosters, which are of a capacity of 1000 amperes each, can build up about 350 volts at full load. Owing to the nature of the distribution described above, there being no section insulators and the boosters, with their respective feeders, being, so to speak, in multiple with each other on a bus bar consisting of the trolley wires and "side feeder," it was considered advisable not to wind the boosters with plain series fields, in which case one machine might happen to back current through and reverse the other. They are, therefore, compound wound, the series ampere turns, however, being somewhat greater than the shunt ampere turns. The shunt winding is supplied with current taken betweeen the bus bar and ground, so as not to be affected by the rise and fall of the booster voltage. The two machines are eight-polar, rated at 350 kilowatts, run at 250 r. p. m., and were built by the General Electric Company. One of them is direct-coupled to a Westinghouse compound 500-hp engine, and the other is belted to a similar engine, the latter arrangement being due to the fact that a machine suited for direct coupling could not be supplied in time to start the line. The plans were only approved in March, the machines were ordered about the first of April and the line was running May 29. Two other boosters are also in use in the same station for long feeders at times of heavy load, the machines being standard 500-volt dynamos and used in multiple with the rest of the equipment at other times.

The arrangement of the feeders described above differs from that ordinarily used with boosters in that each booster does not drive its own load separated from the rest of the system by section insulators, but the two boosters work not only in multiple with each other but with a direct feeder from the main bus bar. This arrangement helps greatly in the distribution of the load and the equalization of concentrated heavy loads over the whole equipment of the station. The same principle is applied so far as possible to the whole system of the Brooklyn Heights Railway, the overhead lines being tied together to an extent limited only by the capacity of the main generators—that is to say, the capacity of all the circuit breakers supplying the feeders, which are tied together in one section, should be less than the capacity of the machines, otherwise the machine breakers will come out on short circuit, shutting down the whole system supplied from that station. Even these large sections are now to be cross connected by the use of fused or circuit-breaker junctions.

The hasty but satisfactory equipment of the Sea Beach line reflects no little credit on the chief engineer of the line, Mr. J. C. Brackenridge, and also upon the electrical engineer, Mr. R. P. Brown.

### Overhead Switches on the Brooklyn Bridge.

The four loops forming the New York terminus of the trolley lines coming across the New York and Brooklyn Bridge have given no little trouble in the trolley switches. The trolley lines are necessarily low, owing to the structure under which the cars run, and the trolley poles are consequently pressed down until almost horizontal. The sharp curves necessary to enter between the columns supporting the structure overhead bring sharp bends into the overhead wire, and twist the wheel flanges at many points considerably out of the general direction of the wire which they must follow. The trolleys continually run off at these curves and miss the switches to the various loops.

An ingenious remedy for this is now being tried on one of the incoming switches and curves. The arrangement consists simply of a shallow, inverted metal trough, about 1 foot in width, with downwardly projecting flanges to keep the trolley from running off at the sides, against which the flanges of the trolley wheel can run and from which they can collect current. The trough narrows at its ends in a V shape, which guides the trolley wheel onto the wire, starting from the point of the V. At switches the trough is full width, so that if the trolley wheel follows the car with any accuracy at all it cannot go wrong at these points. The arrangement is not unsightly in this particular instance, owing to the fact that it is under cover. Its operation appears to be very satisfactory.

### The Output of the Calumet and Hecla Mines.

The statement of the Calumet & Hecla Mining Company for the year ending April 30, 1898, gives the product in refined copper as amounting to 45,194 tons, that for the previous year being 46,238 tons; at the price of 11½ cents per pound this gives a valuation of the annual output of over $9,000,000.

## Electric Traction Between Buffalo and Lockport.

The most recent application of electricity to a road built on a private right of way and formerly operated by steam locomotives was inaugurated on Monday, August 15, on the branch line of the Erie Railroad which runs from Tonawanda to Lockport, N. Y., feeding into the main line of that road. The service is of a mixed type, the passenger traffic being carried on by trolley cars and the freight service by electric locomotives.

The operating company is the Buffalo & Lockport Railway Company, of which Mr. W. Caryl Ely, first vice-president of the American Street Railway Association, is president, and Mr. Burt Van Horn, general manager of the Buffalo & Niagara Electric Railway Company, is manager. C. K. Marshall, superintendent of the Buffalo & Niagara Falls Electric Railway Company, will also be superintendent of the new company.

The Buffalo & Lockport Railway Company was organized in April, 1898, for the purpose of connecting the cities of Buffalo and Lockport, N. Y., by means of a first-class high-speed electric railway. It has acquired by purchase the road formerly owned by the Lock City Electric Railroad Company, consisting of 5½ miles of first-class single track running through the principal streets of the city of Lockport, with its equipment for local business. It has also acquired by a ninety-nine year lease the Lockport branch of the Erie Railroad from Lockport to North Tonawanda, N. Y., consisting of 13½ miles of single track from Lockport to North Tonawanda, with side tracks and switches at way stations and terminals. This road when a part of the system of the New York, Lake Erie & Western Railroad was operated by four steam locomotives. The schedule gave about eight trains per day each way between the principal stations, and a much less number for the less important places. Passengers went through from Lockport to North Tonawanda, from which point they reached Buffalo or Niagara Falls.

The Buffalo & Lockport Railway Company has also acquired by purchase the roads formerly owned by the Buffalo, Kenmore & Tonawanda Railway Company and by the Buffalo, Elmwood Avenue & North Tonawanda Railway Company, consisting of 7½ miles of single track between Buffalo and North Tonawanda and 1 mile of single track within the city of Buffalo. By these tracks it makes connections with the tracks of the Buffalo Railway in the latter city. The total length of the tracks owned or leased by the company is 29 miles.

By traffic contracts with the Buffalo Railway Company and the Buffalo and North Tonawanda Electric Railway this company thus provides a through line from all parts of Lockport to all parts of Buffalo, and also between Lockport and Niagara Falls. It will do all the freight, mail and express business of the Erie Railroad between Lockport and North Tonawanda, and will in many ways become a component part of the Erie system. The cars and trains between Buffalo and Lockport run direct to the main station of the Erie Railroad at North Tonawanda, and the sight of the steam and electric systems side by side at this point and doing business through the same train yard is a novel one.

Work was commenced May 17, 1898, and at midnight on Sunday, August 14, the steam service was suspended. Nothing has since occurred to mar the perfect and punctual operation of the road on the new schedule. It is already doing a heavy business.

Power is obtained from the Niagara Falls Power Company by tapping its long distance transmission line between Buffalo and Niagara Falls at a point between the Falls power house and the station of the Buffalo & Niagara Falls Electric Railway Company at Tonawanda. It is carried at a pressure of 10,500 volts alternating current over three No. 0000 bare copper wires on triple petticoat insulators set on cedar poles, to the rotary converter sub-station located in a new power house at the Lockport terminal of the old Erie branch. Here it is led into six 150-kw stationary transformers of the air-blast type, similar in construction and operation to those installed in the Niagara Street power house of the Buffalo Street Railway. In these the pressure is reduced to 350 volts, and at this pressure the current passes to two rotary converters, where it is converted into continuous current at 500 volts. The rotary converters are standard General Electric six-pole 400-kw 500 r. p. m. machines. The switchboard is of the standard panel type, and consists of one high tension panel for the high-potential transmission, two low-tension panels for the alternating current side of the rotaries, two "K" direct-current railway panels for the direct current sides of the rotaries, and two transformer panels. The air blast for the transformers is furnished by a blower built by the Buffalo Forge Company and driven by a 1½-kw motor.

The switches for the high-tension current are of the quick-break type, each blade being separated from its next neighbor by a marble barrier. The blades are pulled open by means of a hooked stick, the hook being inserted in an eyelet into the end of the blade. The fuses on the high-potential circuits are of the expulsion type, in which the fuse is held between two springs, so that at the moment of fusing the two ends, between which the arc would ordinarily spring, are instantaneously pulled apart. Each of the direct-current panels is, of course, equipped with an automatic circuit breaker. The line is protected by G. E. lightning arresters of the short-gap type, placed on the wall of the sub-station, where the high-potential transmission wires enter the building.

As soon as the present plant is completed another rotary converter sub-station will be erected at Tonawanda, taking current also from Niagara Falls.

From the starting point in Buffalo to the city limits the cars are operated by current from the Buffalo Railway Company's station. The new converter sub-station at Tonawanda will feed 7 miles to Lockport and half way in the direction of Niagara Falls, the converters at Niagara Falls feeding half way back to Tonawanda. The arrangement will be such that the Buffalo & Lockport Railway system can give current to, or take it from, the system of the Buffalo & Niagara Falls Electric Railway. The Lockport converter station will then feed back 7 miles to Lockport and supply current also to the city lines in Lockport itself.

The new rolling stock consists of two 36-ton electric locomotives, supplied by the General Electric Company, for freight service, and ten electric motor cars mounted on eight wheels and built by the J. G. Brill Company, of Philadelphia, for passenger service.

The theory of handling the passenger service has been entirely changed from that in force with steam traction. Instead of long intervals between trains the cars are run on half-hour headway. This requires five cars to operate the 25 miles between Lockport and Buffalo. The speed is high. Over their own right of way the cars ran on their first trip at the rate of 50 miles per hour, including stops. The running time from Lockport to Tonawanda is twenty-six minutes; to Buffalo, one hour and fifteen minutes. In this trip thirty-three minutes are spent in the city of Buffalo in a distance of 6 miles, where the speed has to be kept low to conform to city ordinances. Even with this drawback, however, it is expected that in the near future the running time between Buffalo and Lockport will be reduced to one hour.

The passenger and smoking combination cars are 31 feet 8 inches long over the end panels, and with platforms 4 feet 6 inches long measure 42 feet 4 inches over the buffers. The platforms are inclosed by round-end vestibules with openings on the diagonally opposite corners of the cars. Hinged doors, which fold back against the vestibules, completely inclose the platforms when desired. Folding gates are also provided turning back against the outside of the vestibule. The car is divided into two compartments, one of which is used for smokers and is separated from the remainder of the car by a partition having glass windows on each side of the sliding door. All the seats have spring cushions. The inside finish of the car is cherry, with chipped glass beveled edges in the ventilators. The cars are also fitted with electric heaters, a small one under each seat, and also push buttons.

These cars are run on "T" rails at a speed that will enable them to average 45 to 50 miles per hour. Electric brakes are provided upon each axle, the discs being cast upon the wheels themselves.

The baggage and passenger combination cars are especially adapted to high-speed service. They have a passenger compartment with a seating capacity of twenty-eight and a baggage compartment. The car body is 31 feet 8 inches long over the end panels, 7 feet 8 inches wide at the sills, and 8 feet wide at the widest point. The platforms are 4 feet 6 inches long. The total length over the angle iron buffers is 37 feet 10 inches. Cars and trucks are from the shops of the J. G. Brill Company, Philadelphia.

Each car is equipped with four G. E.-57 (52 horse-power) motors and B-8 controllers. The equipment is similar to that on the new cars used on the long-distance lines of the North Jersey Street Railway Company, of Newark, N. J. The weight of each car loaded is from 20 to 25 tons.

The two locomotives have been built for the purpose of handling the freight business of the road exclusively. The road being a feeder to the main Erie system the freight traffic is considerable. To haul it, therefore, powerful locomotives were necessary, and in them the General Electric Company, which alone has had any experience in building large electric locomotives, has incorporated such improvements as the actual operation of its locomotives on the Baltimore & Ohio Railroad, the New York, New Haven & Hartford Railroad and the Hoboken Shore Road has dictated.

The design follows closely that of the locomotives just mentioned, two sloping shields being placed one on each side of a central cab, the whole carried on two swiveled trucks. The cab frame is made of 1¾-inch x 1¾-inch angles, covered with a sheathing of one-eighth-inch iron.

The platform or main frame is built up of 8-inch channels running the entire length of the platform, and securely riveted to cross plates at the ends directly over the centre truck bearings. Heavy oak buffer beams, to which are attached draw heads and pilots, are secured to the ends of the platform. The trucks have swing bolsters, supported by elliptical springs, and the truck frames are built up of forged and rolled iron securely bolted and riveted together, the pedestals being made of cast steel. The truck proper rests on coil springs, supported by equalizing bars. The wheels are 36 inches in diameter, with steel rims and iron centres.

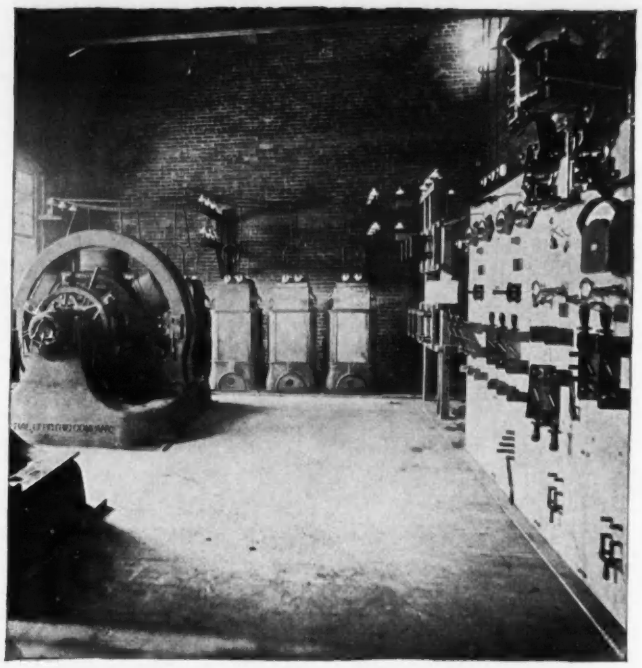
The locomotives are each equipped with four G. E.-55 motors. The drawbar pull at full speed is approximately 3400 pounds, handling a 340-ton train at about 15 miles per hour. The motors are rated each at about 160 horse-power. As the maximum speed required is quite low, two motors are at all times connected in series.

The controller is of the K-24 type, with cut-out wiring modified to fit the special requirements of the equipment in regard to speed. Outside the resistance points only two combinations of the motors are possible, the first throwing all four motors in series, and the second or running position placing motors No. 1 and No. 3 in series, and the pair in multiple with motors No. 2 and No. 4 similarly connected.

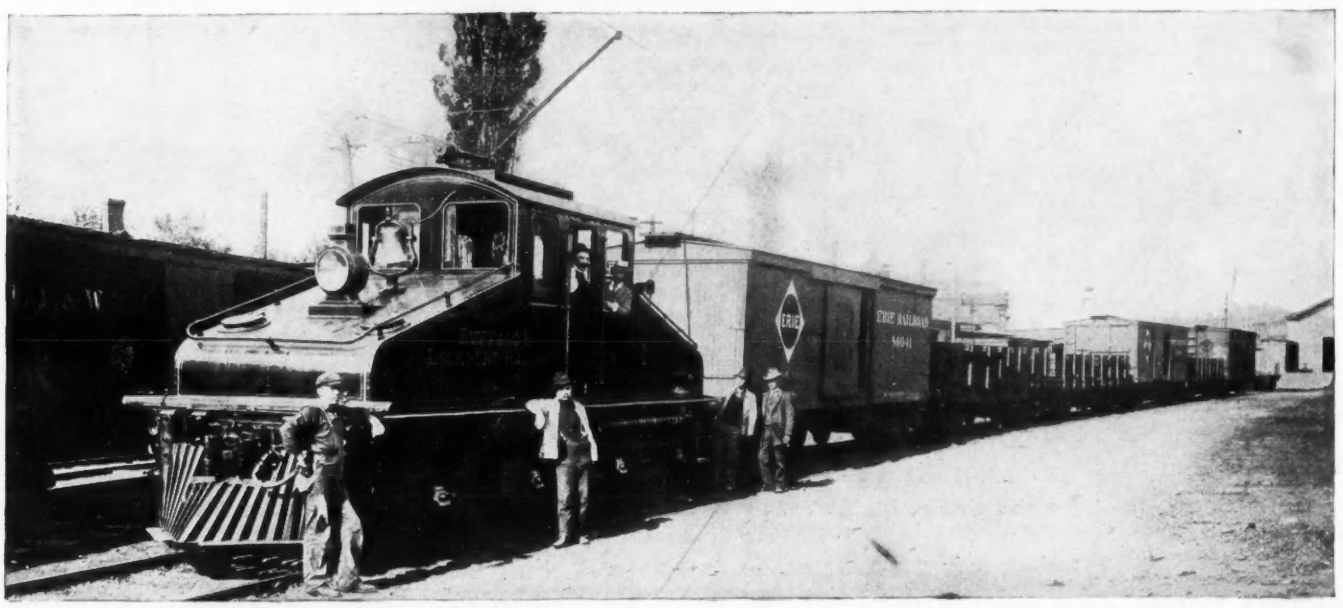
The locomotives are equipped with pneumatically controlled trolleys. With this arrangement it is no longer necessary for the engineer or helper to leave the cab to replace the wheel on the wire or reverse the trolley. This is effected by a handle conveniently placed over the engineer's head. The downward motion is obtained by admission of air to a cylinder, the piston of which in moving compresses the spring holding the pole in place when running. The upward motion is accomplished by the spring and the movement sideways by hand, both pole and handle being on a swivel plate.

The balance of the equipment consists of air brakes, air whistle, bell, air-blast sanding device, air pump, magnetic circuit breaker, magnetic switch, lightning arrester, electric lights, etc.

The locomotives have already been subjected to several severe tests. They are specified to be capable of hauling trains of 300 tons weight, exclusive of the locomotive, which, estimating the average car at 30 tons, would mean a train of ten cars. The locomotives have already proved themselves equal to hauling as many as twenty-eight loaded freight cars at the specified speed of 15 miles an hour.



INTERIOR OF SUB-STATION, SHOWING ROTARY, STATIONARY TRANSFORMER AND SWITCHBOARD.

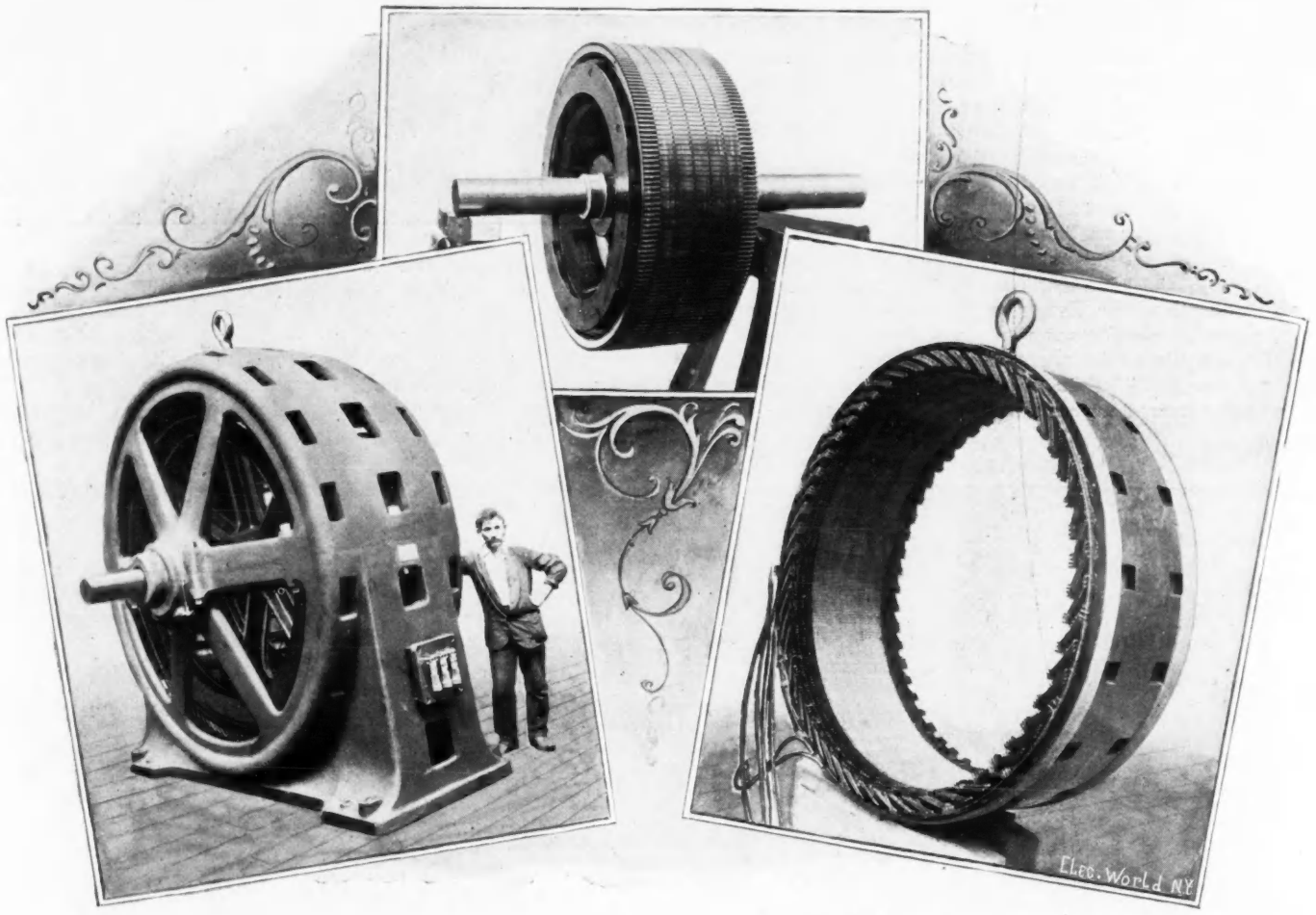



ELECTRIC LOCOMOTIVE HAULING FREIGHT TRAIN AT LOCKPORT.

The transformation of this line from steam to an electrically operated road marks an important step in the employment of current on the steam road. If in its operation it successfully attains the results expected, it will conclusively prove that electricity can be economically applied to the operation of branches and feeders of steam-trunk line systems. It would be too much to expect an immediate conversion of these latter main lines from steam operation to operation by electricity, but with electric locomotives and motor cars profitably carrying on both freight and passenger traffic on their feeders, the entering wedge will be driven still further and the ultimate result will be by so much nearer of attainment.

### The Largest Induction Motor in America.

In connection with the brief description and illustration in The Electrical World of August 27 of the largest induction motor in the world, made by Brown, Boveri & Co., Baden, Switzerland, the largest machine of this type in America may be of interest. It consists of a motor rated at 500 horse-power, built by the Westinghouse Electric & Manufacturing Company. It is of the company's standard Type C wound for three-phase supply at 7200 alternations per minute and 400 volts. It has 36 poles, giving it a magnetic speed of 200 r. p. m., and is designed for 4 per cent. slip at full load. The secondary is wound with a short-circuited squirrel cage bar winding, the primary being also bar wound, and it is to be started by the Westinghouse standard method of starting motors with short-circuited secondaries, namely, the use of a so-called auto-starter, consisting of a set of transformers by which the primary windings can be given a lower voltage until the motor has gained considerable speed, when they can be thrown directly on to the mains. The motor is stated to be designed to develop a starting torque of 2¼ times the full load rated torque. The power factor is given as 93 per cent. at full load, which is apparently a satisfactory figure, considering the low peripheral speed. The dimensions of the motor are: Height, 10 feet 3 inches; floor space occupied, 9 feet 6 inches by 3 feet 6 inches; diameter at the air gap, 7 feet, and the weight is 42,000 pounds. The weight of the Swiss machine mentioned above, which is rated at 1000 horse-power, is 27 tons, which is obviously considerably less than double the weight of the American machine. The peripheral speed of the American machine is, however, much smaller than that of the other, since the diameter of the air gap of the latter is apparently at least 5 feet and the speed is given as 550 revolutions per minute, almost three times that of the American machine, giving a peripheral speed at least 50 per cent. greater. The American machine is to be coupled directly to a line shaft driving a mill in Mexico.




A 500-hp Induction Motor, Its Internal Rotating Secondary and External Stationary Primary.

### Temporary Power Stations of the Metropolitan Street Railway Company.

The surface car lines on Manhattan Island in New York city are rapidly, as every one interested in street railway matters knows, being equipped with an open conduit electrical equipment. The Metropolitan Street Railway Company, which operates almost the entire mileage of surface lines in Manhattan Borough, started about one year ago to install this system on its lines, after a two years' experiment with a few short lines in Harlem. Along with the track work the company commenced the construction of a central power station designed for an ultimate capacity of 70,000 horse-power, and let contracts for the equipment of about two-thirds of this capacity. The construction of this station is, however, on account of its magnitude, progressing but slowly, and to carry the load in the meantime the company put in two temporary power stations, one on Twenty-fifth Street and one on One Hundred and Forty-sixth Street. The track work was actively begun in August, 1897,* and the first line was opened in November. Other lines were quickly added, cars purchased and generators erected to supply them, but the magnitude of the traffic has exceeded all expectations. The temporary equipments mentioned are already loaded, two more lines—namely, the Sixth and Eighth Avenue—are now about ready to be put in service, and winter, with its accompaniment of power consumed in car heaters, is not very far distant. The first big generator of the alternating-current rotary system, it is hoped, will be running in the new power house early next spring, but to tide over the winter two direct-current generators of the type and size now in use in the temporary stations are being temporarily erected in the new station.

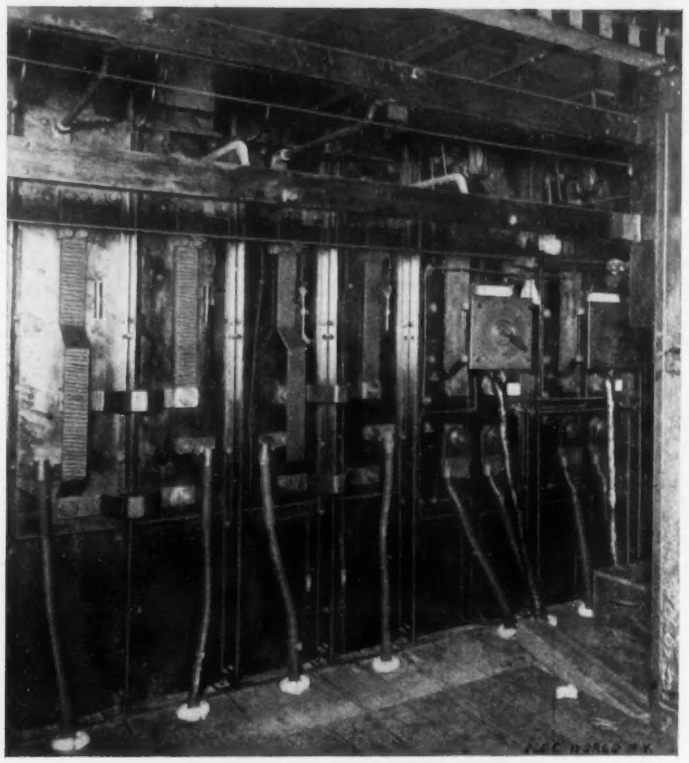
Of the two temporary stations the larger is that on Twenty-fifth Street, the apparatus being in what is known as the Lexington

*See The Electrical World of August 28, 1897, page 239.

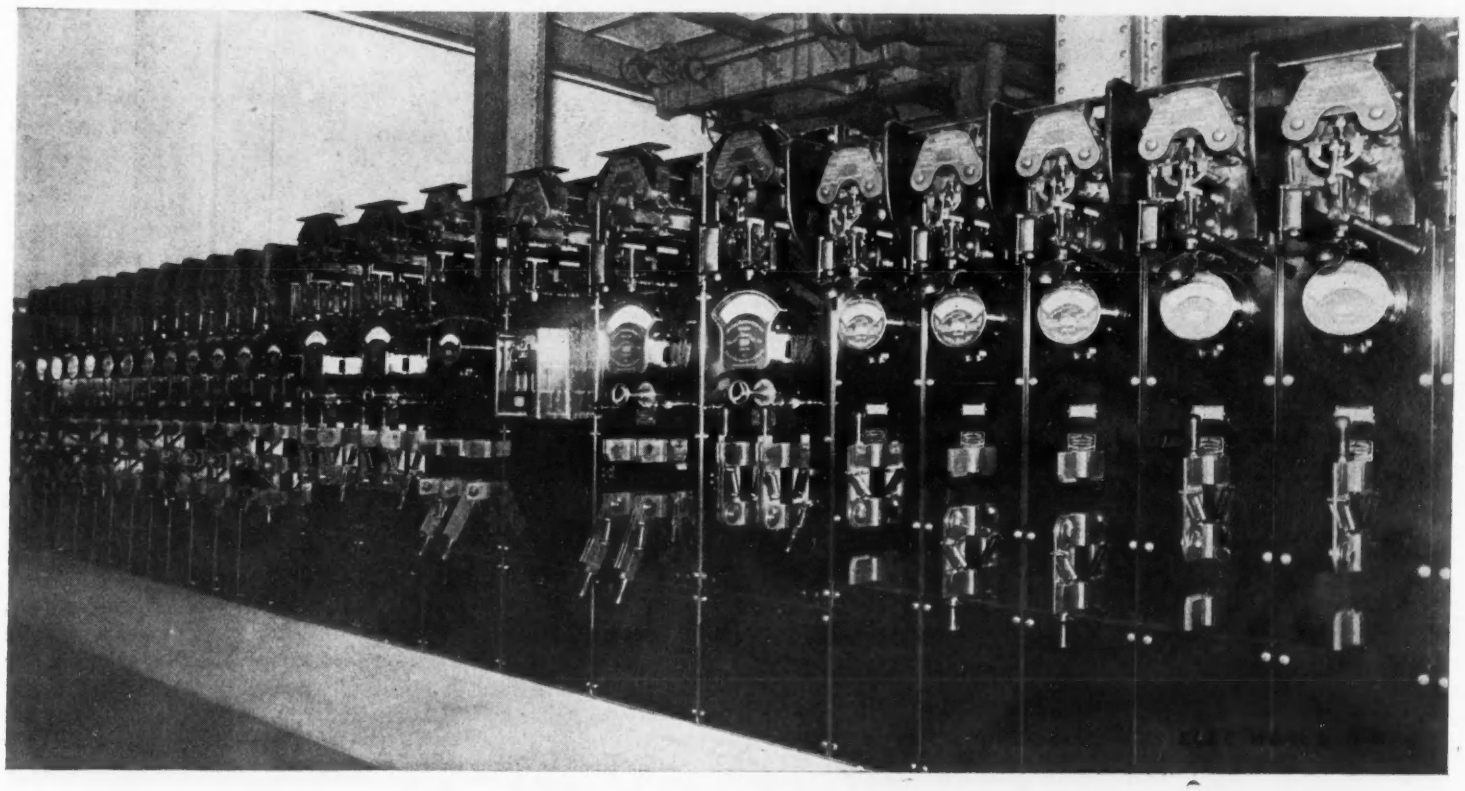
Building, a large office structure erected by the street railway company, the basement of which was planned for an eight-machine cable traction equipment. Four cable machines were installed and are now in use, the remaining space being occupied by four 850-kw direct-coupled railway generators. The visitor is at once struck with surprise at the substantial completeness of this equipment, which is only to be kept in service about a year, and then not even kept in reserve, but to be torn out to make way for a battery of rotaries. Everything is constructed as though it were a permanent equipment for a high-class road. The engines are cross-compound horizontal Corliss, built by the Pennsylvania Iron Works Company, piped below the floor, equipped with emergency governors, a complete gravity oiling system for constantly filling the sight feed oil cups, permanently attached indicator reducing motions, etc. The space occupied by these machines was designed for cable equipment, and several columns rise right through the engines. One column rises between two eccentric rods of the two wrist plates of one cylinder, and the rock arm of another engine valve motion approaches so closely to a column that to give any clearance it is necessary to cut off a rivet head. Naturally no one crane can be run over this machinery, but runways of the four cranes installed for the cable equipment extend over the generators and this helps materially in erecting and stripping the latter.

The generators are new machines built by the General Electric Company, and guaranteed to carry 50 per cent. overload for one-half hour and well able to carry any load from nothing to this overload without sparking and without brush adjustment, as has frequently been shown in the severe service which they have already been compelled to carry. The machines are mounted on substantial brick foundations carried down 25 feet to the solid rock. They are supplied with steam from a battery of boilers, supplying also the cable equipment, this battery having been increased from twelve to sixteen boilers in order to carry the additional load. The boilers are of the B. & W. manufacture, rated at 250-hp each, and the new ones, having to be crowded in a space below the Twenty-sixth Street sidewalk, are mounted in a pit 12 feet below the boiler room floor. They are stoked by automatic stokers supplied by Alfred Box & Co., Philadelphia, the hoppers of the stokers being some little below the floor level, so that all that is necessary to feed coal is to shovel it over the edge of the floor. The whole arrangement is, instead of being inconvenient, unusually satisfactory, the gauge glasses and water-level cocks being about the level of a man's head, and suggests the advisability of elevating boiler room floors above the fire doors in all cases of automatic stoking, or constructing a gallery at that level. The mechanical parts of the stoker likely to be overheated are kept cool by water-circulating pipes, the water warmed therein being afterward used for boiler feeding.

The fire room is supplied with coal by means of a Hunt conveyor, the fuel, arriving in wagons, being dumped first into a weighing hopper, from which it can be fed into the conveyor, which carries it to a 2000-ton pocket over the boilers. Chutes from this pocket, capable of weighing about half a ton of coal at each filling, empty in front of the boilers, the twelve older boilers, of course, being hand-stoked. The conveyor, on its return trip, passes under ash hoppers and serves thereby to remove the ashes. The steam and exhaust piping of the station is put in in duplicate, and the cable and electrical machinery may be piped together or independent.



FOUR PANELS OF THE SWITCHBOARD FROM BEHIND; GENERATOR PANELS TO THE RIGHT AND FEEDER PANELS TO THE LEFT.



PART OF THE SWITCHBOARD OF THE TWENTY-FIFTH STREET STATION.

The most interesting part of the station, however, is the switchboard, which differs considerably from switchboards of overhead equipments, owing to the all-metal nature of the distribution system. The positive and negative sides are both insulated from the ground or are intended to be, and are equipped alike on the board. The latter consists of a long structure of polished slate panels, which has grown so beyond the contemplated plans that its ends had to be swung around into something of a horseshoe shape, and, no further space being at hand in this direction, more panels are to be added on a gallery. The board has at its centre a total output panel equipped with the usual astatic integrating wattmeter rated to carry 8000 amperes, and also equipped with a reserve circuit breaker, which can be, at times of emergency, cut in in place of any one of the machine breakers. By the side of the total output panel is a water rheostat connecting panel for testing purposes, and flanking these two on either side are the machine panels, which are similar in all respects to standard 3000-ampere panels of General Electric construction for overhead traction work. The feeder panels, however, differ. Each feeder is equipped with two panels side by side, one positive and one negative. Each polarity carries a circuit breaker, a round-type ammeter and a single-pole double-throw quick-break switch, the wiring of which is such that the polarity of that feeder can be quickly reversed by throwing the two switches over. In this way grounds on different sections of the system can be kept on the same side of the machines by properly setting the feeder switches, and even if a dozen or more grounds are on the system, provided no two of them occur on opposite polarities of any one section, there is no short circuit. The switch attendants have become expert in keeping out short circuits, which are somewhat more likely to occur with this sort of a system than with the overhead, especially when the tracks in service are being extended or crossed by new work. The most lively attention is, however, demanded when there is a ground on the feeders or underground rails at some point and a grounded car on the lines. As the grounded car moves from section to section, every time the grounded side comes on the positive (assuming that the grounded rail is negative) a short circuit exists and that section must be reversed. Such grounds have frequently been followed by the attendants at the switchboard in this way.

There are now in service from this station some twenty feeders, all, of course, run underground in lead-covered cable. Seven more are to be added, panels for which must be placed overhead. The circuit breakers at the head of the panels, being alternately of opposite polarities, have been separated by partition walls to prevent the current jumping over between the adjacent breakers when either one of them happens to hold an arc through some derangement, an accident which has occurred before these wooden barriers were installed. Another peculiar feature of this board is the fact that no lightning arresters are needed, and on this account the board is remarkably neat. The back of the board is arranged with the buses moved to a considerable distance behind the feeder panels and connected therewith through 1-inch copper rods. The system is watched for grounds by means of ten incandescent lamps connected across the buses, the centre being tapped off to ground. If either group of five lamps burns at full candle power, the other going out entirely, it is known that there is a more or less heavy ground on one side; if one side burns dim and the other comparatively bright there is a weak ground on one side, and if both burn at half voltage the insulation resistance is the same on both sides of the system.

The rated generating output of the station is obviously 3400 kilowatts, and the load already runs at periods of heavy traffic up to and over 3000 kilowatts. Before the station gets through the winter there will probably be some interesting tests of the overload capacity of the dynamos and engines there installed.

The Boiler Room of the Twenty-fifth Street Station, Showing the Automatically Stoked Boilers in a Pit at the Left.

The chief engineer of the whole station, cable and electric, is Mr. G. W. Howard, and the electric generating plant is under the immediate charge of Mr. R. B. W. Peck.

The other temporary station is of similar magnitude and arrangement, and occupies a part of the large and handsome structure on One Hundred and Forty-sixth Street, near Lenox Avenue, a lage part of the building being used for car storage. The equipment here consists of three 850-kw machines of the same style exactly as those described above in the Twenty-fifth Street station, driven by the same make of engines. Besides these there are two smaller machines of about 450-kw capacity each, which were originally installed when the experimental Lenox Avenue line was erected. These machines are mounted on the shafts of Allis-Corliss engines. This gives this station also a rated capacity of about 3400 kilowatts. It is not as yet as heavily loaded as its downtown associate. The switchboard arrangement is practically the same, there being, however, thirty-four feeder panels for seventeen feeders. Steam is supplied by a battery of Babcock & Wilcox boilers, but without any power-conveying or stoking apparatus.

This station is in the immediate charge of Mr. Walter Pearson, the electrical engineer of the company.

## Undeveloped Water Powers of the Little River, North Carolina.

BY A. F. MC KISSICK.

The water powers described in this article are situated on the Little River of Transylvania County, N. C., within 12 miles of the Southern Railway, and 30 miles from Asheville.

This river has a drainage area of 30,000 acres, and while the volume of the stream is rather small there are a series of cascades in the lower part of its course that lend themselves readily to the development of power, requiring in each case very little masonry work.

The falls of Little River are known as Bridal Veil, High, Triple and Hamilton's Mill, named in the order of their descent, and in the opinion of many are unsurpassed for beauty by any falls in the Blue Ridge range of mountains.

The first, Bridal Veil, see Fig. 1, has a fall of 115 feet, and is capable of developing 650 horse-power. A dam about 80 feet in length would afford a reservoir of about 2 miles long, and would be sufficient for the development of the power. The basin of the stream is solid rock, furnishing a good stone for dams and building purposes, and is very easily obtained.

High Falls (Fig. 2), which comes next in order, has an almost precipitous descent of 115 feet, capable of developing 700 horse-power. A dam here would not have to be longer than 90 feet, giving a reservoir of about 1½ miles in length.

Triple (Fig. 3) is, as its name implies, a series of cascades, aggregating 128 feet in descent, with a capacity of 750 horse-power, awaiting development, and is the most picturesque of all the falls. The accompanying illustrations give a very good impression of the beauty and grandeur of these falls, and also of their capabilities in a more utilitarian way.

The last falls on Little River, those at Hamilton's Mill, are now partially used for a saw and grist mill, and have a fall of 96 feet, capable of developing 700 horse-power. At these falls a dam 50 feet in length is all that would be required for their full development. Fig. 4 gives a view at top of falls, Fig. 5 at bottom.

At present the lumber from this mill is rafted down to the French Broad River, and so on to the markets at Asheville and Knoxville.

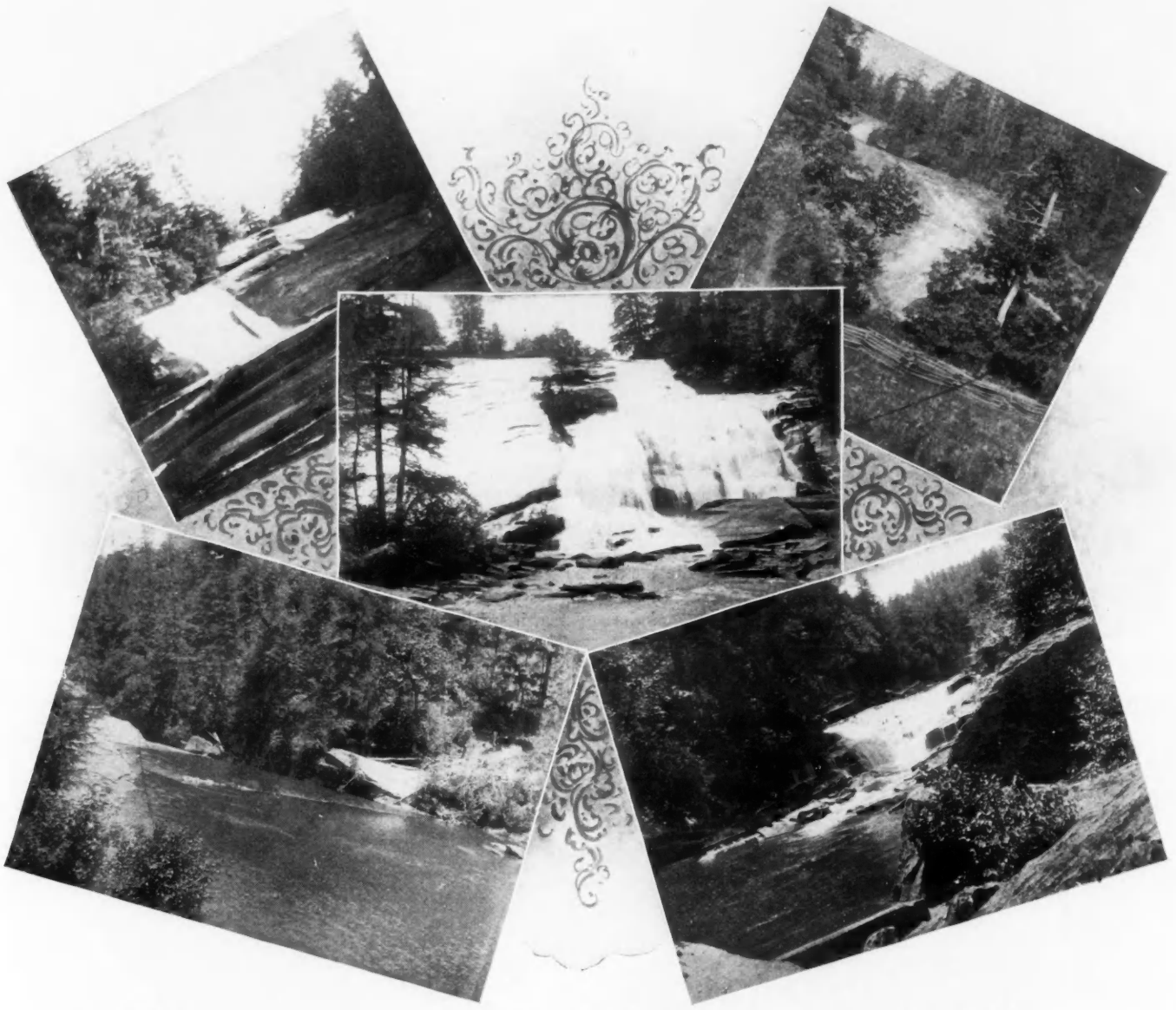


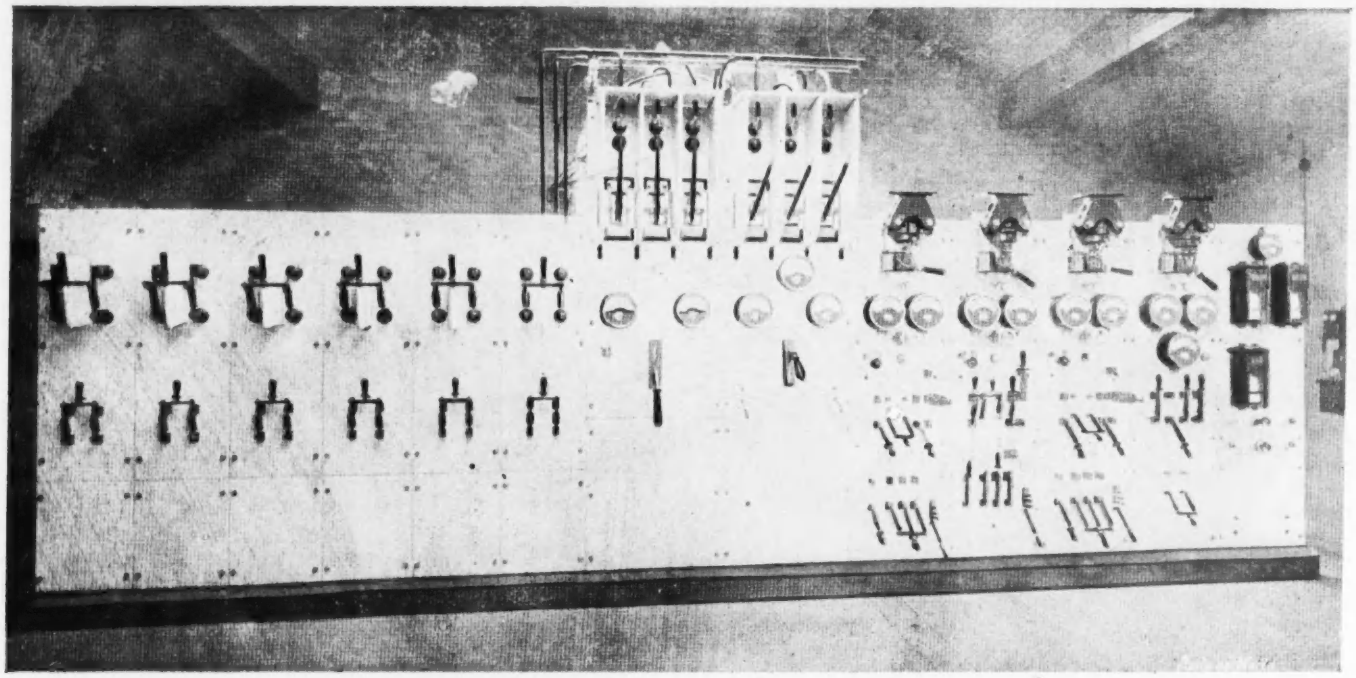
FIG. 3.—TRIPLE FALLS. FIG. 2.—HIGH FALLS. FIG. 1.—BRIDAL VEIL FALLS.
FIG. 4.—HAMILTON'S MILL FALLS FROM ABOVE. FIG. 5.—HAMILTON'S MILL FALLS FROM BELOW.

## Wireless Telegraphy and Yacht Races.

One of the varied applications of wireless telegraphy received an interesting illustration at the Kingstown regatta, says the London "Electrician," when Signor Marconi demonstrated the adaptability of his system to the transmission of press intelligence from a steam launch in motion. The yachting expert on deck dictated his account of the races while these were in progress, and a stream of dictated "copy" descended below deck to Signor Marconi, who sat in a cabin working his transmitter, whence the ether waves carried the news with a minimum loss of time to a fixed receiving station on shore. Arrived at this point, the news was forwarded to the press offices by telephone. It is stated that one edition of the local "Evening Mail" contained two whole columns of news dispatched entirely by wireless telegraphy. This notable event is undoubtedly the germ of an important development of wireless telegraphy in the near future.

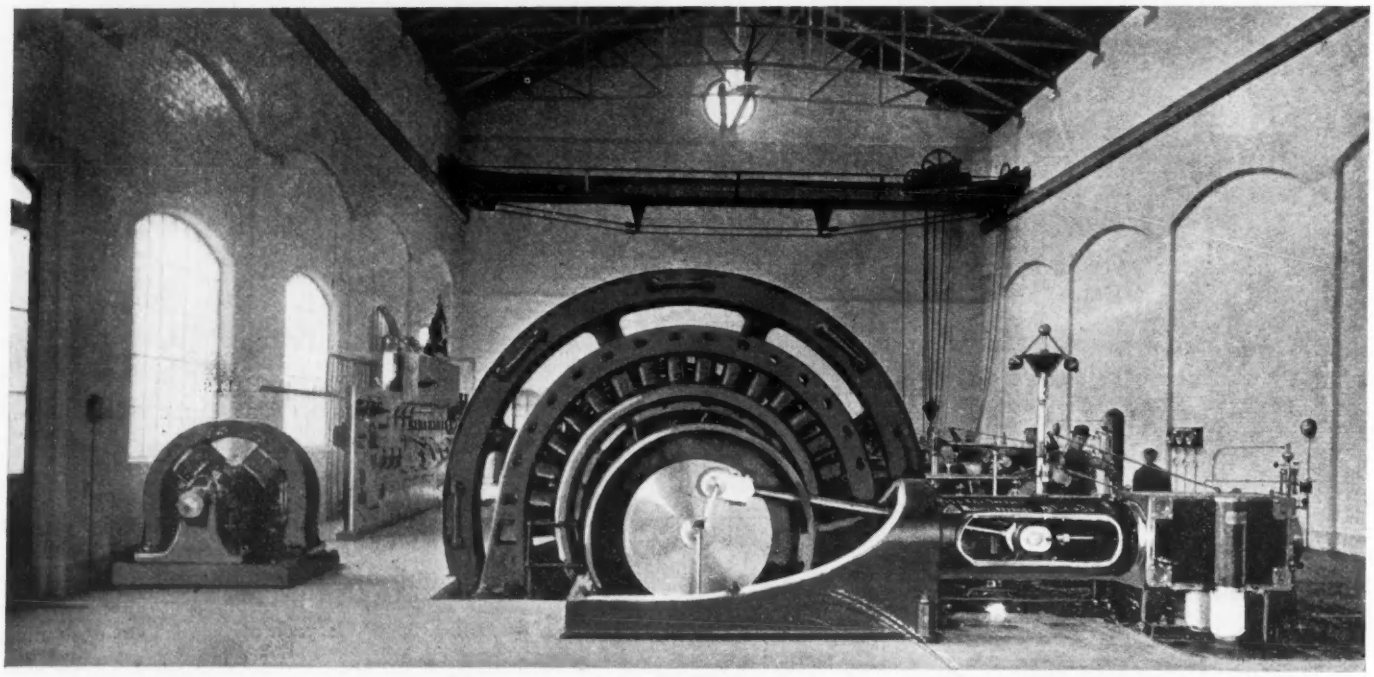
## An English Street Railway System with Multiphase Distribution.

Since the publication in The Electrical World of August 6, 1898, of a descriptive article on the Middlesbrough, Stockton & Thornaby Railway there have appeared in the English technical papers various illustrated descriptions of the equipment of these lines. The accompanying illustrations are taken from the "Railway World" and the London "Electrical Review," and show the main switchboard, with the high tension measuring and controlling apparatus, a view of one of the main generators, and a view of the boiler room with the automatic stokers. A most interesting feature of this plant is the combination of multiphase distribution and storage battery reserve. The storage batteries are placed in the substation supplied from the main plant by the alternating transmission line, and it was desired to obtain some means of boosting the current to charge these batteries at will. Instead of installing an ordinary direct current booster, the booster itself was made a rotary converter and a very ingenious system was devised for adjusting the voltage of the direct current end of the rotary, which, of course, is proportional to the voltage of the alternating current delivered. Step-down transformers for supplying alternating currents to the rotary were made with considerable magnetic leakage, in other words with considerable self-induction, and by means of leading and lagging currents the voltage drop in these self-inductive transformers can be varied widely, giving the proper variation of the voltage delivered. The leading and lagging currents are obtained by varying the field excitation of the rotary, which, if excessive, causes leading leading currents to enter the armature, and vice versa, if small causes lagging currents.



The Main Switchboard.

The maximum distance from the power station to the most distant terminal of the line is only about 4 miles, and with proposed extensions about 3 miles further, a distance which would be considered within the limits of direct current feeding in this country, but which requires some auxiliary system in England on account of the Board of Trade rules with regard to the common return. These specify that the maximum difference of potential in the return system should not exceed 7 volts.



The Main Engine Room, Showing One of the Generators and One of the Rotaries.

### The Welsbach Filament.

The publication of certain patents recently granted to Dr. Auer von Welsbach, and described as follows in the "Journal of the Franklin Institute," suffices to give a general outline of the direction in which he is working.

The patents alluded to describe two materials for the light-giving substance. The first is a fine filament of osmium, one of the metals of the platinum group. It must be prepared with great care, because of the extremely poisonous character of its fumes.

The basis of its selection as the substitute for the carbon filament is the fact that it does not fuse at a temperature much higher even than the fusing point of platinum.

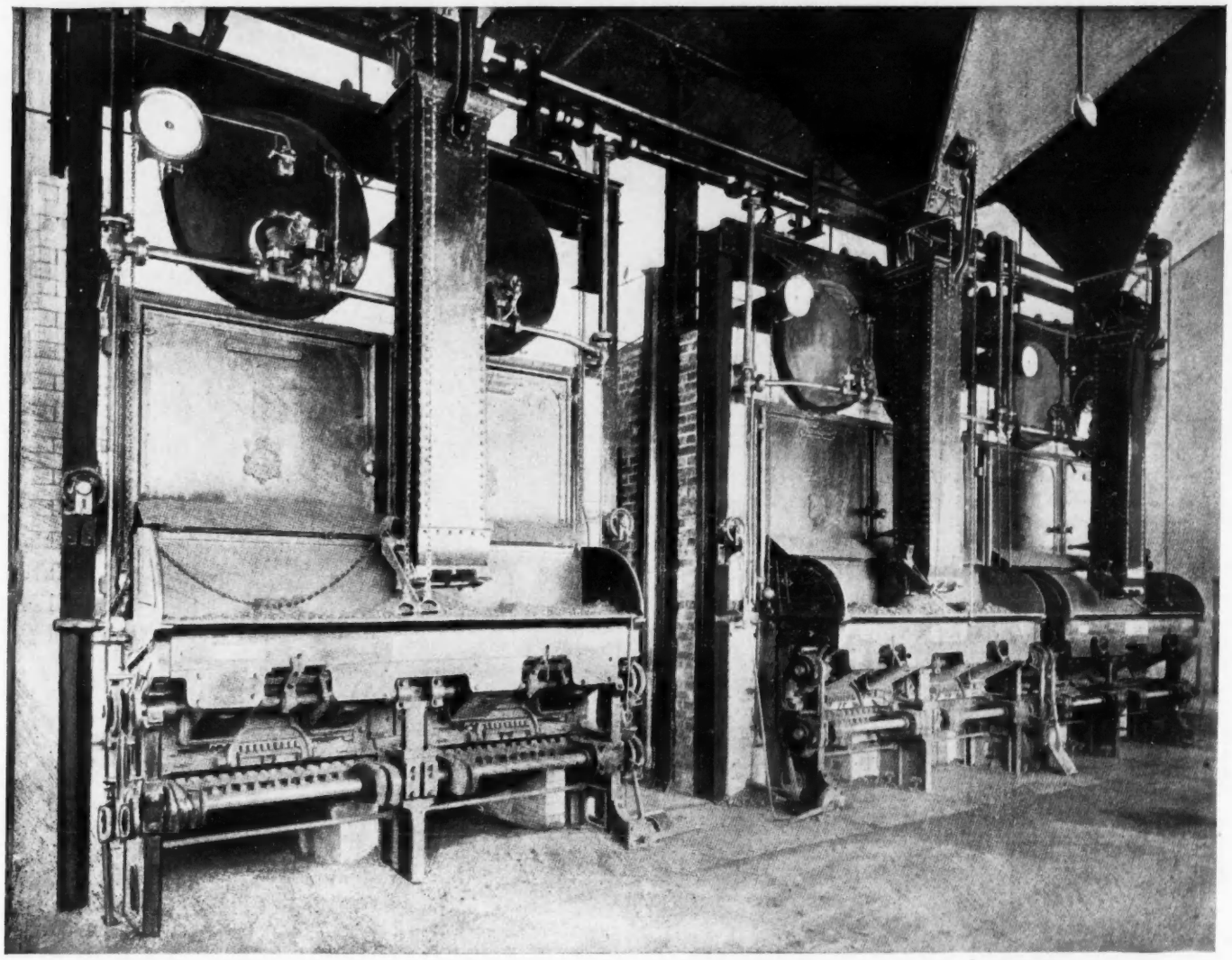
The fact that it is impracticable to fuse osmium (and on this great infusibility its value for Welsbach's purpose depends) makes it impossible to obtain it in any other form than that of a powder which cannot be united into a solid mass by pressure and then drawn into wire. It is necessary then to obtain the osmium filament by indirect means, and for this purpose Welsbach deposits it on a fine platinum wire maintained in an atmosphere of hydrocarbon vapor; and, the platinum wire being heated to incandescence in this atmosphere by the electric current, small quantities of the vapors of osmium tetroxide are blown in from time to time. The result is that a thin layer of metallic osmium is deposited on the platinum wire. This operation, it would seem from the published account, is a slow and exceedingly delicate one, for the deposited film must be quite uniform to answer the purpose, since any irregularity in the deposit would affect the uniformity of its resistance and yield a light more brilliant in spots. Another method of obtaining the deposit is described, which consists in drawing the fine platinum wire through the solution of an osmium salt, and then glowing it in a vacuum. To obtain the film in the required condition, by this method, only an extremely thin layer must be formed at a single operation, so that it must be repeated many times (100 times at least) to obtain the needed uniformity in the superposed layers. Neither of these methods, therefore, seems to present much promise of success on the commercial scale.

A more practical method suggested is the use of vegetable or animal fibres as the foundation for the osmium coating. A liquid pulp is made by mixing finely divided osmium oxide and suitable fibres with sugar solution or other organic cementing material, and, after drying and cutting into the required shape for the lamp, glowing the mixture slightly in an atmosphere of reducing gas. By this and slightly modified methods a carbon skeleton is formed, carrying a certain quantity of unconsolidated osmium. It will be observed that the resulting filament is not a pure osmium filament, but one consisting largely of carbon, and hence open to the same objections as the common carbon incandescent lamps, besides being vastly more costly.

The second proposal of Welsbach is the thoria filament. This substance is one of the rare earths largely used in the manufacture of the Welsbach gas mantles, and is known to possess light-emitting qualities of a high order.

To obtain this filament the inventor employs an extremely thin platinum wire (0.02 millimeters in diameter) approximately as thin as a single fibre of the silk cocoon, and draws this successively through elastic cheeks, which are kept moistened with a solution of a salt of thorium. After each drawing the wire is glowed, and the operation must be repeated, as in the one above described, many times, in order that the resulting coating shall have the necessary permanency.

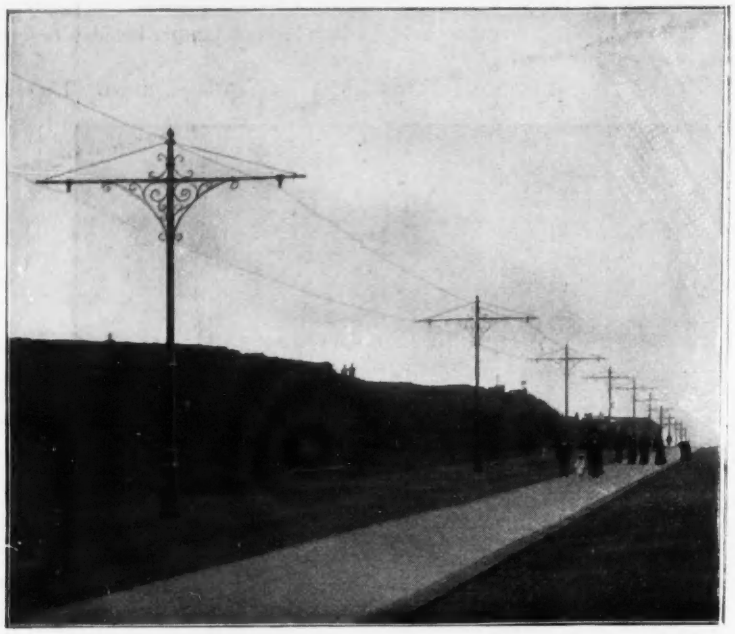
The resulting thread, then, is a platinum core, surrounded by a dense incrustation of thoria. The heat-resisting qualities of the incrusting oxide are said to be so great that the platinum within may be melted without affecting it, while the luminous intensity of the thoria is very great at temperatures low compared with other substances. For this reason the temperature may be kept below the fusing point of platinum.



THE BOILER EQUIPMENT OF AN ENGLISH STREET RAILWAY SYSTEM.

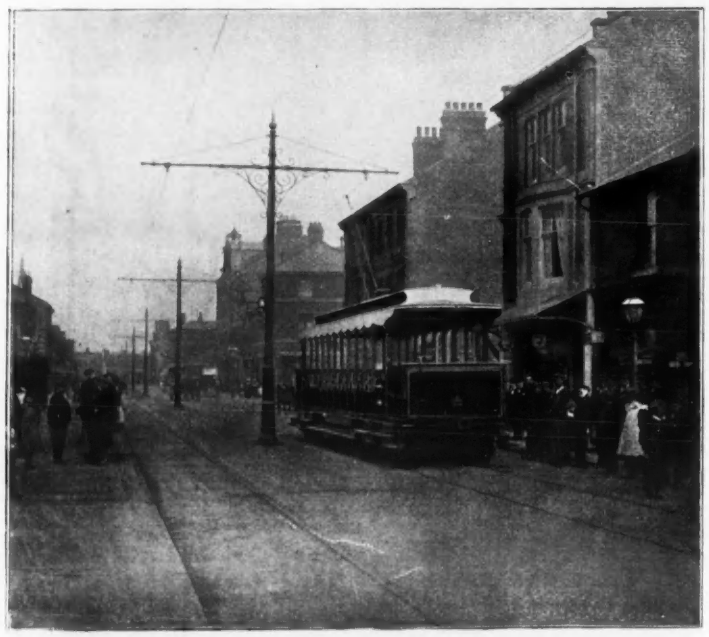
### The Overhead Trolley in England.

The English system of overhead railway line construction differs somewhat from the American, owing in part to the more fastidious æsthetic tastes of the public and in part to the different nature of the cars. Bracket construction is used to a greater extent than in this country, and the poles and fittings are as a whole quite ornamental. The accompanying illustrations show some examples of this, the brackets being apparently supported by a graceful scroll of twisted ironwork, but in reality supported by diagonal tension lines running to the top of the pole above. English street railway cars are very frequently double-decked, and to prevent interference



An English Suburban Line.

of the overhead trolley with the passengers on the upper deck the trolley base is often placed on a post or column rising several feet above the top of the car. A device unknown in this country is that known as the Dickinson side trolley, whereby the trolley wire may



A Rarity on English Lines—an Open Car.

be considerably offset from the centre of the track below it, the two trolley wires on a double track line being in cases carried over one track. If the line runs near the side of the street this allows a very neat arrangement of the overhead wiring on side poles with brackets. The trolley base may be at the centre or one side of the car, and the trolley pole extends out sideways at a considerable angle with the fore and aft line. To prevent the trolley wheel from leaving the wire under this condition the harp holding the wheel is swiveled on the end of the pole by a vertical pin, contact with the wheel and wire not being immediately in line with the pin, but somewhat to the rear, so that the wheel flanges as the car moves along adjust themselves to the direction of the trolley wire.

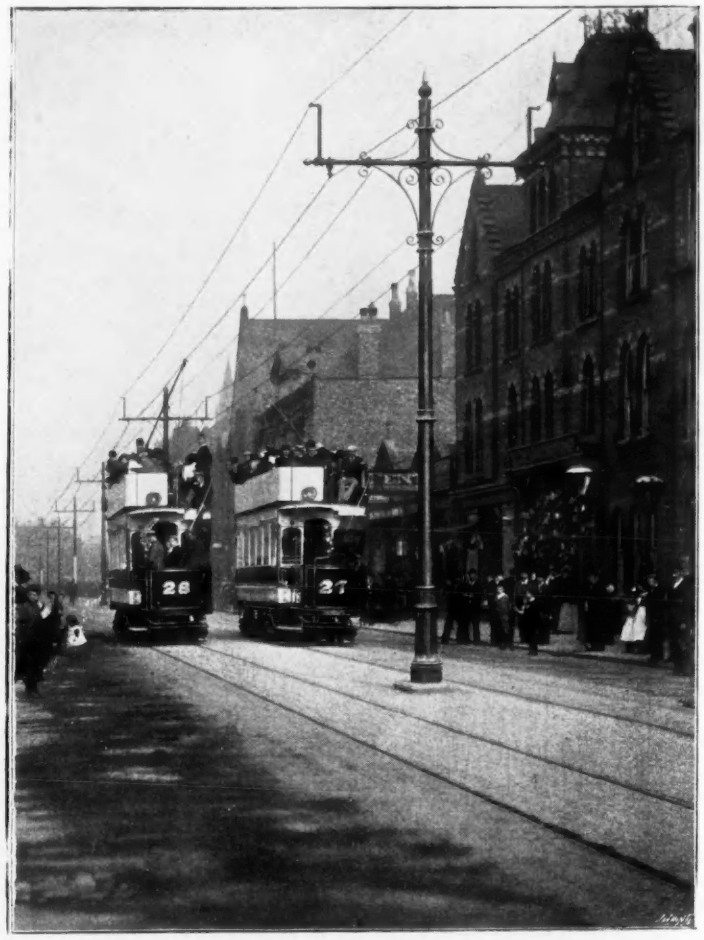
### Telephones in Cape Colony.

According to a consular report the telephone service of Cape Colony is under the control of the colonial government. On the 9th of April, 1898, there were 1535 instruments in use, and the revenue for 1897 amounted to $66,137.22. There are 869 miles of wire and 780 subscribers. Seven exchanges in the colony work on the single-wire system, but arrangements are now being made to have all lines duplicated, and in future no exchange will be established except on the metallic-circuit system.

In the course of the next few months the underground cable system in Cape Town will be completed and exchanges established in the suburbs.

### The Diesel Motor at the Munich Exposition.

At the exposition now being held in Munich the display of Diesel motors occupies a special building, several manufacturers licensed under the Diesel patents making exhibits. Among these are two




The Overhead Lines and Cars of the Middlesbrough, Thornaby and Stockton Road.

built by the Maschinenbau Actien Gesellschaft, of Nurnberg, one of which is a 40-hp engine fitted with two cylinders coupled directly to a Schuckert dynamo. Another motor exhibited propels a Linde machine for the production of liquefied air, and others drive centrifugal pumps. Besides the four firms exhibiting at the Munich exposition three others in Germany are now engaged in the manufacture of Diesel motors.

### Electric Railways in Shanghai.

The United States consul general at Shanghai states that a special committee of the city council contemplates the construction of about 18 miles of street railway equipped with the overhead trolley system. The concession is to be given for the construction, equipment and operation of the line to the highest bidder for thirty, forty or fifty years, according to the tender that may be accepted, the concessionnaire to pay the city a percentage of the total gross receipts during this period.

## Electricity in the United States Capitol.

BY BUSHROD C. WASHINGTON, JR.

A VAST amount has been written concerning the Capitol building of the United States, but somehow no one has yet undertaken to present to the electrical engineers of the world a detailed description of the electrical machinery which controls the artificial light and ventilation of this tremendous building.

The Capitol is 751 feet 4 inches in length, and 350 feet in width, covering over three and a half acres of ground. The great dome terminates in a lantern 15 feet in diameter and 50 feet in height, which is surmounted by the statue of Freedom, towering 307½ feet above the esplanade. During night sessions of Congress the lantern is lighted by gas, day sessions being indicated by the presence of the United States flag on the Senate and House flagstaffs.

The electrician has in view lighting the lantern for night sessions, with three rows of colored electric lamps, using the national colors, red, white and blue. Red is to signify that the Senate is in session, white the Supreme Court, and blue the House. All three sets of lights are to be lighted when both the House and Senate are in night session.

There are two separate and distinct power plants, located respectively in the Senate and House portions of the terrace on the west front of the Capitol. The terrace is really a part of the Capitol, and was added partly for giving the building better architectural proportions and partly because of the great and growing necessity for more room. The walls are built of marble, granite and brick, and the roof is of brick arches supported by heavy iron I beams. The upper surface is heavily concreted, and numerous skylights furnish ample light for the corridors below. The steam plant on the House side consists of two Babcock & Wilcox boilers, one of 350 horse-power and one of 150 horse-power. The steam pressure is 200 pounds. The 350-hp boiler has just been installed. The 150-hp boiler supplies steam for the House plant. This boiler has developed over 230 horse-power, as indicated by the electrical output, viz.: 1500 amperes at 115 volts. An expansion joint connects the steam mains of the two boilers. A No. 8 Reilly boiler feed pump is used. The separator is located between the boiler room and the dynamo room and is fitted with a Bundy automatic trap. The separator and steam mains are covered with Nonpareil cork packing. The condenser is a 10-inch Buckley, injector type.

Steam is conveyed in 10-inch mains to the two Westinghouse compound engines. Each of these engines is direct connected by means of a flexible coupling to a 75-kw Westinghouse generator. The generators are the standard type of multipolar direct-current machine generating 600 amperes at 125 volts and 300 r. p. m. The usual voltage is 115 at the switchboards. The generators have been run day and night for six weeks at a time without stopping, and during those periods of long continuous runs have been subjected to overloads of more than 25 per cent. without the slightest injury to the machines.

The switchboard is the Westinghouse railway type 5, made of Italian marble 2 inches in thickness. There are five panels, and a small additional marble slab has been added on the right of the board for an equalizer switch. Beginning on the left, the first and second panels are provided with 1000 and 1200 ampere ammeters, respectively, and six double-pole switches. These twelve switches control the motor and light circuits, for the House ceiling, the corridors, and the Capitol grounds.

The third panel consists of one 2000-ampere ammeter; one 125-volt voltmeter; two 2000-ampere circuit breakers and a 125-volt Weston direct-reading voltmeter. The other two panels are each provided with an 800-ampere ammeter, a 600-ampere circuit breaker and a three-pole switch and rheostat. Each panel has a pilot lamp. Equalizer bus bars have been added to the board since it was first installed.

There is urgent need of another generator of the direct-connected type, and an appropriation has been obtained to enable the purchase of such a generator, with a capacity of not less than 225 kilowatts. The present steam plant is sufficient for supplying steam for the present equipment and the contemplated increase.

The Senate plant is considerably larger than the House plant, and besides supplying current to a large number of lamps also furnishes power for several motors driving large ventilating fans.

The steam supply for the Senate plant is furnished by three Babcock & Wilcox boilers, one of 100 horse-power and two of 200 horse-power each. The boiler feed pump, separator, and condenser are of the same makes as those in the House plant. Twelve-inch steam mains run from boiler room to dynamo room. The mains and separator are covered with magnesia non-conducting material. There are three generators in this plant. Two are 75-kw Westinghouse generators of exactly the same pattern as those in the House plant, and the other is a 187½-kw Westinghouse generator. The latter at 250 r. p. m. generates 1500 amperes at 125 volts. All three generators are direct connected by means of flexible couplings to Westinghouse compound engines. The oil from these engines, as well as those in the House plant, runs into Westinghouse separators and is used over and over again. The boilers, engines and generators of this plant have been run for long periods at a time without a shutdown, and were frequently subjected to heavy overloads without injury to the machinery. The switchboard is of Italian marble, 2 inches in thickness, and contains six panels. The two left-hand panels are for the two 75-kw generators and equipped like panels 4 and 5 of the House plant. The third panel is for the 187½-kw generator and carries the following: one 2400-ampere ammeter, one 2000-ampere circuit breaker, three single-pole switches, and a rheostat. The load panel carries a 125-volt voltmeter, one 5000-ampere main ammeter, one 1500-ampere circuit breaker, a switchboard voltmeter, one 1500-ampere double-pole switch and one 1500-ampere single-pole switch. Panel No. 5 carries a 1200-ampere ammeter, and six double-pole switches for the various circuits. Panel 6 only differs from panel 5 in the ammeter, which is 1000 amperes capacity. Each panel is provided with a pilot lamp. Equalizer bus bars have been added since the plant was first built.

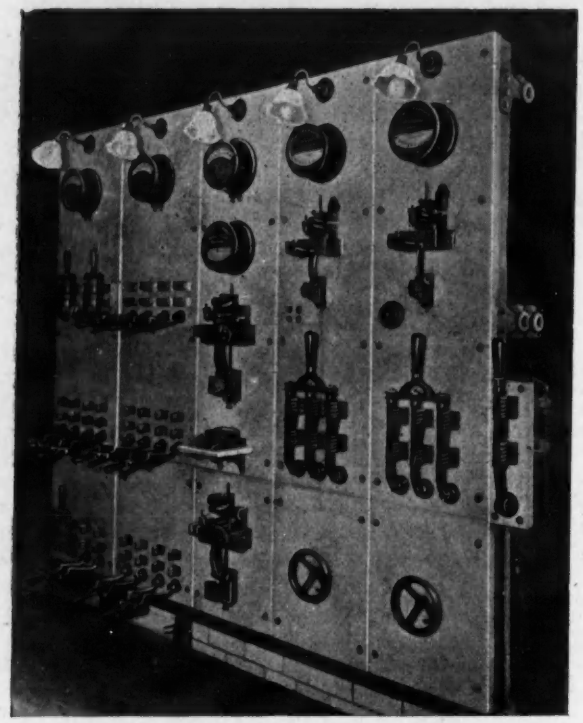
The floor plans show that every inch of available space has been utilized to the best possible advantage. Owing to the shape of the room and the projecting walls, which interfere with a good view of the entire plant, a photograph of this room was not obtained. The arrangement of the engines and generators is very compact, and only sufficient room is left between the walls and the machines to render the parts accessible to the attendants. The forced arrangement of the machinery keeps the attendants constantly on the move, as there is no one position from which they can watch to advantage the three generators and the switchboard. The two plants are about 370 feet apart, measured across the court on which they open. The cables are run in a conduit laid across the court. For a time the plants were run in multiple without an equalizer, the connections being made by nine 0000 positive and nine 0000 negative cables. At present there are the same number of positive and negative cables and nine 0000 cables connect the equalizer bus bars of the two switchboards.

Each station has a telephone, and the attendants call up each other when they desire to run the plants in multiple, and also when they desire to shut down either of the plants. The attendants in each station are notified when adjournments take place, so that they can cut out the lights in their respective ceiling circuits. They are also notified when the current is required for the House or Senate ceiling on dark days. There are 1400 16-cp lamps over the House ceiling, and 1200 over the Senate ceiling.

The light is thrown downward through glass panels set in iron frames. The roof is about 15 feet above the ceiling. In the Senate chamber the ceiling panels are painted with the symbols of War, Peace, Union, Progress, the Arts, Sciences and Industries, and those of the House of Representatives with the coats-of-arms of the States. When the lights are on the effect is beautiful, as the light passes through these finely colored panels and lights the Chamber and Hall with a soft glow that is pleasing to the eye. The many long corridors are brilliantly lighted by large clusters of lamps, the immense size of the building rendering it absolutely necessary to depend on clusters instead of single lamps. In some of the rooms the huge chandeliers are of the richest designs, and are highly ornamental, notably in the President's and Vice-President's rooms in the Senate wing. These chandeliers were originally lighted by gas, but were taken down and fitted with electric lights by the chief electrician. Visitors who employ guides are always shown these fixtures. Mirrors at the ends of the rooms

multiply the chandeliers until they disappear in the distant perspective. In all there are about 8000 incandescent lamps, a number many times too small to adequately light the building, so that gas is also used. There are many fine points about the building, especially in the rotunda and statuary hall, which could be effectively brought out if there were sufficient power to light the lamps when in position.

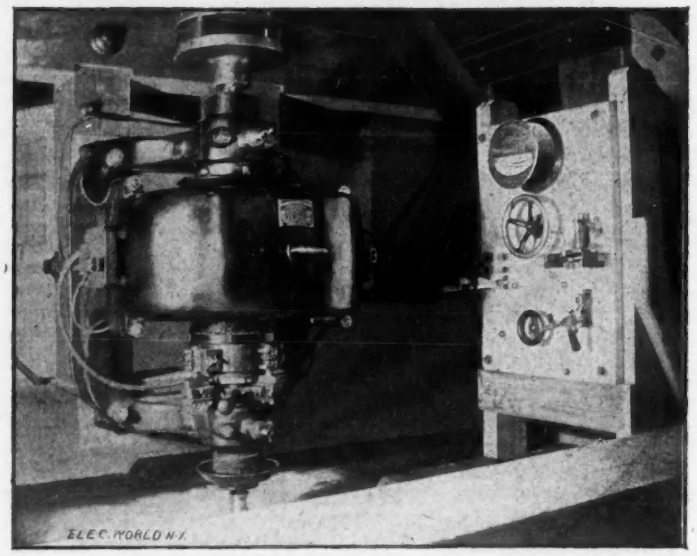
There are nearly 150 1000-cp inclosed Manhattan arc lamps on four circuits. These lamps light the East and West fronts of the building, and the grounds. They burn from 100 to 150 hours without being trimmed. The mains are placed underground. The conduits were built and the new posts and fixtures supplied by J. P. Hall, of New York. The manholes are brick-lined, with cement bottoms fitted with drain connections. The tops are of cast iron, with a simple locking device. The lamps in the grounds are arranged at short intervals along the walks and driveways and are placed so closely together that one can read a paper while walking through the grounds at night. Many of the ornamental posts used for gas lighting were reconstructed and equipped with arc lamps. The electrician in charge states that these lamps rarely get out of order, and that their mechanism is so simple and accessible that repairs are easily and quickly made. The beautiful clear white lights in these grounds make a strong contrast with the yellow clusters of incandescents which light the library building and grounds adjoining. The installation of electric lighting in the grounds rendered necessary considerable trimming of the trees bordering the walks, and also rendered the grounds safer to pedestrians.



The Switchboard of the House Plant.

The effects following the substitution of electric lighting for gas lighting are very marked, and the benefits are of great importance. There was always a noticeable rise in the temperature on the floor of either the House or the Senate following the lighting of the 1200 to 1500 gas burners over the ceilings; but since the installation of electric lighting no marked rise has been noticed, and consequently no sudden change has been required in the operation of the ventilating system. The occupants are also safer now from injury from falling glass. During cold weather in consequence of the sudden lighting of 1200 to 1500 gas burners, the hot air which came in contact with the plates of glass in the skylight caused such violent ratios of contraction and expansion between the outer and inner surfaces that the large plates were frequently shattered. Since the introduction of electric lighting there have been comparatively few plates shattered from this cause. The temperature over the two ceilings due to heat from gas gave readings varying from 90° to 130° Fahr. Under the present system the temperature rise rarely exceeds 10°. The wiring over the ceiling was done by J. P. Hall, of New York City.

The ventilating system is practically as perfect as can be attained by the use of the best of modern appliances and engineering skill. The ventilation of the Capitol was carried out under the plans of Prof. S. H. Woodbridge, heating and ventilating engineer, of Boston, Mass. The ventilating fans are driven by electric motors. An 18-hp Westinghouse multipolar motor is directly connected by means of a quarter-turn flexible coupling to a fan 10 feet in diameter, built of steel. The motor is shunt-wound for 110 volts. This motor undergoes a very severe service, often running for one or two months without stopping. A field rheostat is provided, consisting of 162 turns of No. 12 wire, and carrying the 5.6 amperes of field current. The fan driven by this motor at its lowest speed of 125 revolutions delivers 35,000 to 36,000 cubic feet of air per minute to the Senate chamber. At a speed of 150 revolutions the fan delivers 48,000 cubic feet of air per minute. The air is carried by one channel to the Senate floor, and by another to the gallery. The temperature of each supply is under independent control and the gallery supply is a degree or two higher in temperature to reduce the tendency of the air from the gallery to fall to the floor of the Senate chamber. The air is passed through the floors, and the velocity of the flow reduced by means of large diffusing surfaces at the points of issuance into the chamber. This result is obtained by having finely divided openings for each desk in the floor risers, covering about 100 square inches in addition to 120 square inches in the desk-leg diffusers. In the gallery the air is diffused through the chair legs and in the reporter's gallery through the stool legs. The air discharged through the Senate ceiling is removed through the roof by means of an 8-foot inverted Blackman wheel run by a direct-connected Westinghouse 8-hp motor at 130 r. p. m. This motor is located over the press gallery. Another large exhaust fan driven by an 8-hp motor of the Westinghouse multipolar shunt-wound type exhausts the air over the Senate chamber. This motor is arranged with special bearings for operation with the shaft in a vertical position. These two fans and motors are mounted on frames of massive construction and are exceedingly stable, producing no noticeable vibration and running without noise. A small compartment was built for the attendant, who has telephone connection with the chief engineer. This process of removing the air is done with an expenditure of only one-twentieth of the power required by the former method. The hot-air fan is driven by an 18-hp Westinghouse motor of the same type as previously described.




A Fan Motor on a Vertical Shaft.

The terrace is ventilated by a Sturtevant fan driven by a motor built by that company. The motor is wound for 110 volts, at 1500 r. p. m. The fan runs at 225 r. p. m. This company also furnished the two 10-foot fans driven by Westinghouse motors previously mentioned.

The cloak rooms are connected by air ducts with the roof, and the smoke-laden air is taken out by small exhaust fans, at the rate of about 1000 cubic feet of air per minute, from each cloak room. There is an inverted Blackman fan, motor driven, placed in the

ceiling of the Senate toilet room and the air is kept pure and fresh, as there is a strong current between the open door and the exhaust fan.

In the chief engineer's office there is a system of gauges, thirteen in number, by which the steam and water supply for heating and ventilating is always under observation. There is also an Edson recording gauge for keeping a constant record of the boiler pressure. In his private office is located a three-panel switchboard, on which are mounted ammeters, switches and circuit breakers for the large fan motors in the terrace and the exhaust fan over the press gallery. Under each ammeter is a card, showing the number of amperes of current required to drive the fans at different speeds. This affords a simple system for indicating the amount of air sent into the various parts of the building, and is a great factor in the close regulation of temperatures.

On the west side of the Senate wing is located a Sprague electric elevator of 4000 pounds capacity, and a maximum speed of 300 feet per minute. This elevator is run for the exclusive use of the Senators and Senate employees.

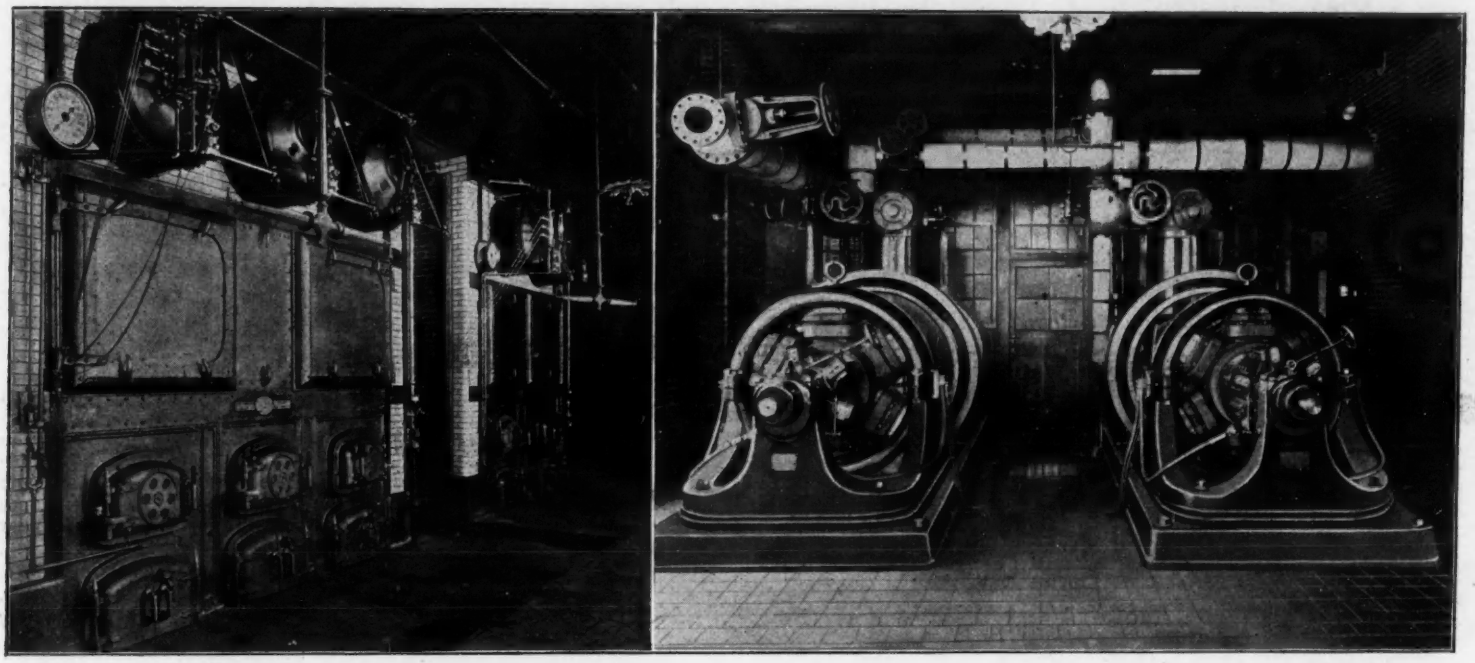
The graphophone plays an important part in the House and Senate proceedings, and there are many of them in almost constant use. The official stenographers, who record the speeches and debates, alternate every fifteen minutes, and during the intervals they read their notes into the graphophone receiver. The record cylinder is taken off immediately and sent to the typewriters' room, where a corps of experts place the cylinders on their graphophones, and as the graphophones reproduce the speeches they are typewritten. Two copies are made, so that a Senator or Representative receives a copy of his speech, as it was delivered, within fifteen or twenty minutes from the moment he yielded the floor to another. After he has corrected his copy it is sent to the government printer, and appears next morning in the "Congressional Record." All the graphophones are run with current taken from the lighting circuit. They were originally operated by storage batteries. Charging the batteries required considerable time, and they were not always available and had the habit of giving out at inopportune times, so that they had to be discarded. The chief electrician overcame all the difficulties by utilizing the current from the lighting circuit. Two 110-volt, 32-cp lamps are connected in series multiple with the motor. The lamps are so placed that they furnish light to the typewriter, thus rendering double service.

At present the members call the pages by pressing electric buttons at their desks, doing away with the noisy custom of clapping hands, a custom still retained by the senators. There is a 200-drop annunciator on either side of the floor of the House, and an attendant sees to it that prompt service is rendered at all times, and also that the pages answer calls in proper rotation.

When books are desired from the congressional library it is the work of a very few moments to have the desired volume transferred from its shelf in the library to the member's desk. Calling a page the order for the book goes to the receiving station and is sent to the library through a pneumatic tube. The book is sent over in a heavy leather case, which travels in a steel carriage on a rope cable. The cable is driven by an electric motor in the basement of the library. The current for the motor is supplied by the library electric plant.

The Western Union and Postal Telegraph Companies and the long-distance telephone render excellent service for communication with the outside world, not only for the senators and members, but the large corps of newspaper correspondents who throng the building. The three companies maintain offices at both ends of the Capitol.

Congress has already begun to interest itself in acquiring the Great Falls of the Potomac, and the electrical development of the power there. There are so many electric light and power plants now operated in Washington by the Government that the question of economy renders it advisable to build a large central station to supply the many demands for light and power. I desire to express my thanks for the valuable assistance rendered me in the preparation of this article by the architect's office, the chief electrician and the chief engineer of the Senate.



THE BOILER AND ENGINE ROOMS OF THE HOUSE PLANT.

### Resistances for Absorbing Large Powers.

A contributor of "L'Electricien" describes an ingenious construction of rheostat for absorbing an output of 400 kilowatts used in testing the generators in the station at Nancy, France. The rheostat consists of galvanized iron netting ordinarily used in protecting the underground distribution cables, the particular advantage obtained in using this material apparently being the enormous radiating surface per unit cross section. A strip of this netting about 11 inches wide, composed of sixteen strands of galvanized iron wire with a cross-section of about 8-100 of a square inch, the whole strip being 180 feet long, absorbs 500 amperes at 240 volts, the strands remaining at a temperature below that of the fusing point of lead.

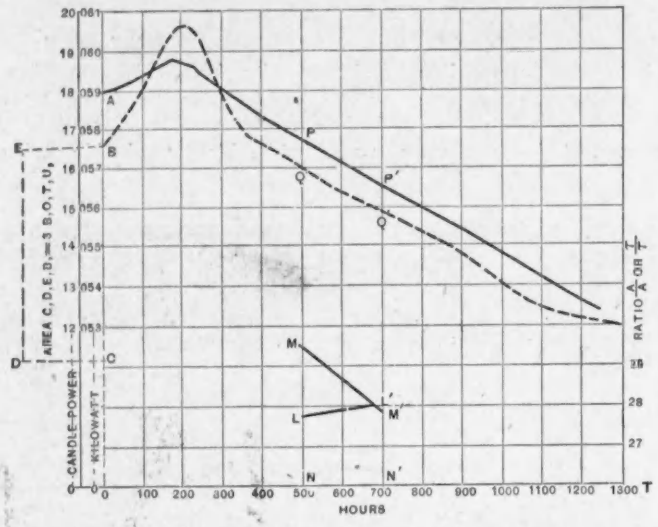
### Search Lights Mounted on Captive Balloons.

It is said that the War Department of the Russian Government is conducting a series of tests with projecting lanterns mounted in captive balloons, the current being supplied through the cables holding the balloons to the earth.

# DIGEST
OF
# CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

## Lights and Lighting.

SMASHING POINT OF INCANDESCENT LAMPS. Carter. Lond. "Elec. Rev.," August 19.—A description of a method of determining what is known as the smashing point in the life of a lamp (as the candle power of a lamp diminishes when the lamp grows older there is a point at which it is cheaper to throw the lamp away than to let it burn out, and this age of the lamp is termed its smashing point). He assumes that instead of breaking the lamps they are transferred to places where less light is required




after that age has been reached; in his calculations he assumes that the cost of this transfer is added to the initial cost of the lamp. The full line in the adjoining diagram gives the average relation between candle power in a definite direction, and time of burning for lamps of a particular type; the dotted curve gives the relation between the power taken and the time of burning; in any time represented by *O N*, for instance, the amount of light obtained from the lamp in cp-hours is represented by the area *O A P N*, and the amount of energy used by the area, *O B Q N*; to the latter is added the area *C D E B*, representing the total cost of the lamp. The smashing point will be reached when the ratio of the total amount of light obtained to the expenditure on the lamp is as great as possible—that is, when the ratio of the area *O A P N* to the area *O C D E B Q N* is as great as possible; this he shows analytically to be the case when the ratio of these two areas is equal to the ratio of the distance *P N* to *Q N*; the equality of these ratios can be determined with sufficient accuracy by finding the ratio of the areas and the lengths of these lines, for a time represented by *N* and again for a time represented by *N'*; let *N L* equal the ratio of the areas and *N M* the ratio of the lines for the first case and similarly lettered lines in the second case, then the intersection of these two lines joining similar points will give the point at which these ratios are equal, and the time corresponding to this point is the smashing point; in the case illustrated this point is about 670 hours for that particular lamp. He then discusses the question of whether or not there may be a second maximum point, and shows how to find this out. The particulars required to construct the original curves should be known to the makers of the lamp, and he suggests that a table giving the smashing point for different values of the ratio of the cost of the lamp to that of a unit of energy would be of considerable value to large consumers.

## Power.

SPEED REGULATION IN POWER DISTRIBUTION.—Lond. "Elec. Eng.," August 19.—An answer to a request to state the relative advantages and disadvantages of direct-current and multiphase-current systems as far as speed regulation alone is concerned.

HUNTING IN ELECTRIC LIGHT ENGINES.—Lond. "Elec. Eng.," August 19.—Several answers to a request to state what the cause of this hunting is and how it may remedied.

---

SNOQUALMIE FALLS TRANSMISSION.—"West. Elec.," August 20.—A brief, illustrated description of this transmission plant, with which power is to be sent to Seattle and Tacoma, Wash.; the work of construction is now well under way; the illustrations show the work accomplished.

SNOQUALMIE PLANT.—"Elec. Eng.," August 25.—A short article on this transmission plant (see abstract above). It is expected that within a few months 4000 kilowatts will be transmitted to Seattle and 2000 to Tacoma; the Falls are about 24 miles from Seattle and 34 from Tacoma. The transmission voltage will be 29,000 at the Falls; it has been decided to use aluminum wire for the transmission line, as the cost of it is cheaper than that of copper; the metal will contain 99.30 per cent. of aluminum and 1.50 per cent. of copper; about 150,000 pounds of it will be used; there will be two circuits of three wires each, to each of the cities. 30,000 horse-power are available at the Falls at extreme low water.

CANON CITY.—"Elty," August 31.—A brief description of this plant, which has just been started, and with which power is transmitted to the Cripple Creek gold mines, 24 miles distant. The generating plant is in the midst of extensive coal fields, and is said to be one of the largest and best equipped electric plants in the West.

LARGE ENGINES FOR CENTRAL STATIONS.—"Eng. News," August 25.—An illustrated description of one of the two engines of 1500 horse-power for the central stations in Berlin, Germany; it is a cross-compound condensing engine.

## Traction.

ALTERNATING-CURRENT TRACTION. Davis and Forbes. "Eng. Mag.," September.—The second article on this subject (see "Digest" August 6). In this one they consider in detail the indirect application of alternating currents to railway work; they consider three cases. the first where the source of power is a considerable distance from the railway, then when it is at one end, and finally when it is at the middle of the line. In order to compare the relative first cost and operating expenses of the two methods—namely, that of a cheap source of power located at a distance and that of the application of power from points along the railway—they consider the definite case of a high-speed line running between New York and Philadelphia, a case in which they claim that electric traction is the only satisfactory or profitable solution. They show how fallacious the usual assumption is that the utilization of a cheap source of power at a distance results in greater economy than the use of power stations close to where the power is applied. A tabulated estimate is given of the first cost and running expenses of the two methods; these show that the items which must be added to the cost per car mile by the use of two-water power located 100 miles away, about balances the greater cost of fuel, wages, etc., when the stations are located close to the track and operated by steam power, and hence the total expenses will be practically the same; as the transmission line costs $25,000,000, the interest on this is the total increase in the expenses when the water powers are used instead of the steam power plants. They claim to show conclusively by this that it would not pay to utilize the water powers.

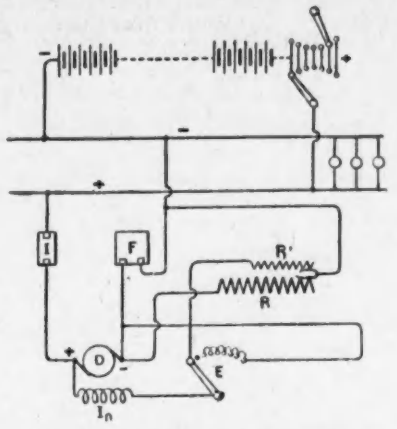
UNDERGROUND RAILWAYS OF LONDON. Cooper. "Eng. Mag.," September.—An illustrated article describing the construction of the various underground railways, chiefly the Metropolitan, which is operated by steam; a brief reference to the electric underground roads is also given.

POWER FOR KEEPING A CAR IN MOTION.—"El'ty," August 31; reprinted from the Lond. "Railway World."—A short article in which a clear and simple explanation is given of the way to calculate the power necessary to keep a car in motion on a level and on grades; the formulas are already well known. He assumes that the average pull is equal to about 30 pounds per ton, which may, under very favorable conditions, be as low as 10 or 12 pounds on a level steam railway.

## Installations, Systems and Appliances.

STARTING GAS ENGINES.—Lond. "Elec. Rev.," August 19.—A long abstract, with some illustrations, of the article abstracted in the "Digest" June 11. A description is given of a method of starting gas engines in private plants when a battery of accumulators is available; it appears that a number of difficulties arise, and these are overcome by the method described; advantage is taken of the fact that the shunt-wound dynamo, while acting as a motor, will revolve in the same direction while the current is in the opposite direction. The arrangement is shown in the accompanying diagram. *I* and *F* are two switches, the latter being automatic; the rheostat, *R*, should be so arranged that one part is always in circuit during starting, while the other part is divided into a large number of sections to be successively cut out; the second rheostat immediately above it is cut out by the same moving contact; connection is made, as shown, to an insulated contact at the head of the field regulator, the handle of this regulator resting upon that contact during starting; this is, therefore, cut out entirely before the field rheostat is moved, in order that the magnetic field should have its maximum value at the moment of starting. To start the motor the switch *F* is at first left open and the contact above the resistance, *R*, is moved to the left; there should be no compression in the gas engine until the proper speed has been reached. The resistance above *R* might be omitted by placing the lever of the resistance *E* to the extreme right, but this would cut down the

field current, owing to the resistance *R*, and there might be a dangerous current in the armature. To make a sure start of a 45-hp engine required 90 to 110 amperes during 25 to 30 seconds; a 25-hp motor connected to a heavy shaft required 70 amperes for about twenty seconds; a 50-hp engine required 85 to 90 amperes; these




figures are about two-fifths of the maximum power produced, but the time required is very short. A single rheostat can be made to serve the purpose of starting a number of engines in the same installation; a diagram showing this is given.

CHARTERS TOWERS.—Lond. "Elec. Rev.," August 19.—A brief, illustrated description of the plant in this town in Australia.

### Wires, Wiring and Conduits.

RULES AND REGULATIONS. Cahen. "Elek. Zeit.," August 4.—A discussion of those adopted in Germany.

### Electro-Physics and Magnetism.

CATHODE RAYS PARALLEL TO ELECTRIC FORCE. Lenard. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He describes what is said, in the abstract, to be a new and important discovery, resulting in the further confirmation of the emission theory of cathode rays. When a beam of these rays is transmitted along the lines of force of an electrostatic field, the deflection by electrostatic or magnetic forces undergoes a modification; he shows that the transmission of cathode rays through the electrostatic field in the direction of the lines of force diminishes their velocity.

RADIATIONS FROM THORIUM COMPOUNDS. Schmidt. "Wied. Ann.," 65, page 141; abstracted briefly in the "Elek. Zeit.," August 11.—Thorium and its compounds emit rays which are similar to those from uranium; they will blacken photographic plates through paper and are absorbed by metals and other dense bodies; they make the air a conductor of electricity; are refracted and probably diffusely reflected, and cannot produce chemical reactions; they are distinguished from uranium rays in that they are not polarized by the passage through turmaline. The rays from fluorspar, turpentine oil, zinc, etc., are distinguished from the uranium and thorium rays by the fact that they do not make the air a conductor.

SOLAR RADIATIONS AND ELECTRICITY. Bach. "Comptes Rendus," 126, p. 479; abstracted briefly in Lond. "Elec. Rev.," August 19.—In order to solve the question whether solar radiations are transformed into electricity, he carried out a series of experiments with the reduction, electrolysis and photolysis of carbonic anhydride. No conclusions are given in the abstract.

ABSORPTION OF ELECTRIC WAVES BY WATER. Drude. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He made experiments with glass troughs containing water, the thickness of the layer of water being varied.

ELECTROLYTIC THERMOPILES. Duane. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," August 19.—He made experiments with dilute solutions to test the validity of Nernst's formula. The apparatus is reproduced in the abstract; the circuit is made of tubes filled with the liquids, so as to avoid electrodes. As far as the results go they completely verify Nernst's theory, both with one and with two electrodes.

CONDUCTIVITY OF MIXED SOLUTIONS. Hopfgartner. "Zeit. Phys. Chem.," 25, page 115; abstracted briefly in Lond. "Elec. Rev.," August 19.—He describes a method of calculation, the results of which were found to agree well with certain experimental determinations.

CONDUCTIVITY OF DILUTE SOLUTIONS. Schaller. "Zeit. Phys. Chem.," 25, page 497; abstracted briefly in Lond. "Elec. Rev.," August 19.—The results of experimental investigations of the electrical conductivity of dilute solutions at temperatures up to 100° C.

MAGNETIZATION OF HOLLOW AND SOLID RINGS. Kirstaedter. "Wied. Ann.," 65, page 72; abstracted, with some of the illustrations, in the "Elek. Zeit.," August 11.—In the field of solenoids up to 300 units Grotrian found that solid and hollow iron cylinders of the same length and outside diameter, but different thicknesses, have the same magnetic moment; the reason was thought to be the magnetic screening action which the outside iron had on the inside. In the present paper experiments are described which were made to find out whether there really is such a screening action; he therefore used a holiow and a solid ring in the place of the cylinder, and magnetized it peripherically. He used a solid ring and then made it hollow, and finally fitted a solid ring into the hollow space; the curves of magnetization are given. His conclusions are that a screening action of the outer layers, as claimed by Grotrian, could not be found in the case of the rings.

MAGNETIC AFTER-EFFECT. Fromme. "Wied. Ann.," No. 65, page 41; abstracted in the "Elek. Zeit.," August 11.—He describes researches to determine the after-effect which follows a reduction of the magnetizing force. In conclusion he shows how the experimental results can be explained by the theory of rotating molecular magnets.

---

HYDRAULIC ILLUSTRATION OF WHEATSTONE BRIDGE. Hallock. "Elec. Rev.," August 31.—A reprint of the article abstracted in the "Digest" last week.

### Electro-Chemistry and Batteries.

ELECTROLYSIS OF ALKALINE CHLORIDES. Wohlwill. "Zeit. f. Elektrochemie," August 4.—A very long article, in which he describes researches made to investigate some of the secondary reactions to which are due the formation of hypochlorites, chlorates, and perchlorates. A question of great importance, both scientifically and practically, is to determine how the anions of the oxygen acids of chlorine, like *ClO*, can be brought into solutions which contain only *Cl*, *OH* and *O* ions as anions, and this is the problem which he endeavors to solve. Extended researches were made at different voltages, and the results are given in curves and tables; from these researches he concludes that with the very smallest e. m. f. with which an extremely small current can be maintained there is a formation of hypochloric acid; it is also proved that below 2 volts there may be a formation of the chlorate. The formation of the chlorate does not depend on the addition of *Cl* or *OH* ions; nor is there a secondary chemical reaction similar to that in the formation of the hypochlorite; the chlorate is generally formed together with the hypochlorite, and it is thought that the latter has something to do with the formation of the former. In the repeated electrolysis of the same solution the chlorate products increased constantly, while the hypochlorite products diminished; from this it follows that in course of time, in the continued electrolysis, the chlorate products increase, and that the solutions containing hypochlorite give more of the chlorate during electrolysis than plain alkaline chlorine solutions; it is almost certain, therefore, that the chlorate is produced by the hypochlorite. With circulating electrolytes the hypochlorite products at the end of the electrolysis were appreciably greater than with a stationary electrolyte. An important result is the variation in the amount of the products, due to the voltage and the current density; researches made between 2.1 to 2.5 volts showed the following: With increasing voltage the total output of the hypochlorite and the chlorate increases; with increasing voltage and current density the relation of the chlorate to the hypochlorite increases. Under the same conditions the output of hypochlorite increases at first and then diminishes. A striking result was that the relative output of the hypochlorite at low voltages of 2.1 to 2.2 reaches 50 per cent., which has never been observed before in strong alkaline solutions. His results are contradictory to those obtained by Oettel and by Haber; he discusses this disagreement. In conclusion he gives the principal results of his researches, briefly; the electrolysis will take place at a difference of potential of at least 1.2 volt between the anode and the hydrogen electrode, forming hypochlorite; the formation of hypochlorite in large quantities will begin to take place above 2.1 volts, and depends on the secondary chemical action of the chlorine and the alkali; the chlorate is produced by an ion reaction, which is possible only by the addition of positive electricity; it is formed from the *ClO* ions which have been formed.

ELECTROLYSIS OF ALKALINE CHLORIDES. Winteler. "Zeit. f. Elektrochemie," August 4.—A continuation of his serial describing researches. He discusses briefly the formation of hypochlorites, chlorates and perchlorates; no conclusions appear to be drawn.

EXTRACTION OF ZINC; COWPER-COLES PROCESS.—Lond. "Elec. Rev.," August 19.—A brief description, with illustrations of the apparatus. The process is intended to apply to refractory ores like those at Broken Hill; the process is claimed to have entirely overcome the difficulties encountered, and has the advantages of economical working and purity of products; it has been tried on a commercial scale at the experimental works in Cornwall, where 40 to 50 tons of ore per week have been treated. The anodes are of sheet lead and the cathodes of aluminum. The difficulty of the roasting has been overcome by the addition of a mixture of other ores. The sulphur is oxidized in the roasting instead of being driven off; the zinc is leached with a weak solution of sulphuric acid, and is deposited either in the form of plates or zinc sponge, which, when dried, is a substitute for zinc dust, for which there is considerable demand. By using a suitable strength of solution only the zinc and copper are removed from the ore, while the other metals present are not dissolved; the lead and silver remaining in the residue can be extracted by any of the well-known methods. A more detailed description is promised.

SOLUTION OF NOBLE METALS. Margules. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He found that platinum may be dissolved in acids or caustic alkalies by passing a secondary current from an induction coil through an electrolytic cell with platinum electrodes. He also obtained a solution by inserting the cell between the hammer and the anvil of the interrupter, in which case it was accomplished by the extra current. Gold was similarly dissolved, but the solution of carbon in a similar way has not yet been accomplished; if carbon could be made to combine with some anions some important new developments in organic chemistry might be expected.

POLARIZATION CAPACITY OF REVERSIBLE ELECTRODES. Elsa Noumann. "Zeit. f. Elektrochemie," August 18.—If an electrolytic cell is placed in one branch of a Wheatstone bridge it will not act like an ordinary resistance, but like a resistance with a capacity in circuit with it; it was first thought that this polarization capacity acted like that of a condenser, but Wien and Orlich have shown that this is not the case; Warburg showed how the polarization capacity could be calculated theoretically for the so-called unpolarized electrodes; the researches described in the present article were made to demonstrate his method experimentally.

DETERMINING HEAT OF DISSOCIATION OF ELECTROLYTES. Van Laar. "Zeit. Phys. Chem.," 24, page 608; abstracted briefly in Lond. "Elec. Rev.," August 19.—He points out a source of error in such determination.

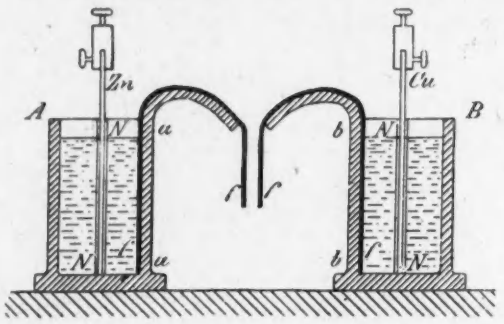
LEAD-ZINC-CADMIUM STORAGE BATTERY.—Lond. "Elec.," August 19; abstracted from "L'Ind. Elec."—A description of the Werner accumulator, which was noticed in the "Digest" May 21 and June 4.

---

STORAGE BATTERY.—"West. Elec.," August 27.—A reprint of the discussion of Appleton's paper, which was noticed in the "Digest" last week.

## Units, Measurements and Instruments.

DANIELL STANDARD CELL. Grotrian. "Elek. Zeit.," August 18.—A description of a convenient and simple form of this standard cell. While the Clark and Weston standards are superior, the Daniell is often sufficiently exact and has the advantage of being easily constructed in the present form, which avoids all necessity of stop cocks such as are used in the Fleming form. The arrangement is shown in the adjoining figure; there are two retaining cells, which




are provided with a long lip on one side; a piece of glass bent to this shape and inserted in an ordinary rectangular cell would also answer; one of these contains the zinc and its solution, while the other contains the copper and its solution; the plates should be held in a fixed vertical position, as, for instance, by means of grooves in the side of the cell; the heavy black lines *f f* are pieces of filter paper 2 or 3 inches in width, the ends hanging down over the ends of the lips and lower than the surface of the liquids; each is first saturated with its solution; by capillary attraction the liquids will be drawn over slowly, and those that mix will drop off, thus keeping the solutions pure; to accomplish this there should be about five strips in the zinc solution and two strips in the copper solution; when in use the two overhanging parts of the strips are brought together, being pressed together with the fingers until they adhere. The copper plate should first be freshly plated electrolytically with copper and the zinc plate should be amalgamated; the irregularities of this cell are due to the coating of copper, which should, therefore, be as fresh and pure as possible; there is practically no effect of temperature on the value of the e. m. f.; the density of the zinc solution should be 1.200 and of the copper 1.100, which are the same concentrations as those used by Fleming. He made a number of determinations of this cell as compared with a Clark, which had been standardized by the Reichsanstalt; the mean value of the e. m. f. which he recommends under these circumstances is 1.101; the resistance of this cell is several thousand ohms, and it will stand short-circuiting as well as the Fleming cell; the e. m. f. arises slowly when the cell is not in use, the rise being about 1 to 2-thousandths of a volt during eighteen hours.

ELECTROMOTIVE ACTION OF CADMIUM AMALGAM. Jaeger. "Wied. Ann.," No. 65, page 106; abstracted with a curve in the "Elek. Zeit.," August 11.—A contribution from the Reichanstalt in which he describes experiments with cadmium amalgams of different composition. He found that amalgams containing 5 to 15 per cent. of cadmium are absolutely alike with reference to the e. m. f., and do not change to a one-hundredth of a millivolt; with more than 15 per cent. they are not permanent; the e. m. f. increases gradually, approaching that of pure cadmium; the results are given in a curve. A rod of cadmium which has been amalgamated is very changeable in its electromotive properties. For the cadmium cell he recommends a more dilute amalgam than one-sixth, as the latter is near the bending point of the curve.

GALVANOMETRY OF SUDDEN DISCHARGES. Witting. "Wied. Ann.," No. 7; abstracted briefly in Lond. "Elec.," August 19.—An ordinary mirror galvanometer may be used for measuring the intensity of rapidly recurring discharges such as those from an influence machine, but if the discharges are not perfectly regular the needle will oscillate. A much more certain method is based on the method of multiplication or of Toepler's reversals; if the spark current is sent through a galvanometer the needle begins to oscillate about the new zero $+ a$; commute the current when it reaches the first turning point and the zero will then be displaced from $+ a$ to $- a$, and on repetition the needle oscillates between two new positions from which the current intensity is easily calculated (no further description is given in the abstract). Experiments with a large machine show that the current depends largely on the resistance of the circuit and length of the spark gap, but increases in direct proportion with the speed of revolution.

MEASUREMENT OF OSCILLATING CURRENTS. Kopp. "Elek. Zeit.," August 11.—An abstract of a paper from a Swiss scientific journal on the measurement of constant and rectified oscillating currents by the electromagnetic rotation of the plane of polarization of light; in the paper he describes a method for determining the constant of the apparatus.

ELECTRICAL INTERFEROMETER MEASUREMENTS. Drude. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He examined the indications of this apparatus and came to the conclusion that it was unsuitable for measuring electric waves.

METER FOR ACCUMULATORS. Aron. "Elek. Zeit.," August 18.—A reprint in full, with illustrations of the paper, an abstract of which was noticed in the "Digest" July 16.

CONDENSER FOR INDUCTION COILS. Dubois. "Wied. Ann.," No. 65, page 86; abstracted, with some of the illustrations, in "Elek. Zeit.," August 11.—He measured the secondary current with an electro-dynamometer, varying the resistance in the secondary circuit and the capacity of the condenser shunting the brake in the primary. Three of the six curves are reproduced in the abstract; one of them shows that a condenser of too great a capacity can reduce the current below the value which it would have without a condenser; he also showed that a condenser at the spark gap of a primary can increase the current appreciably, even doubling it, but that the capacity of the condenser is determined by the resistance in the secondary circuit; with an increase of this resistance the capacity diminishes.

---

INDUCTION COIL CONDENSERS. Dell. "Elec. Rev.," August 24.—A brief description of some experiments, in which the condenser was connected in various ways. No conclusions are drawn, as this is left to the reader.

## Telegraphy, Telephony and Signals.

SPARK TELEGRAPHY. Tietz. "Elek. Zeit.," August 18.—A long article describing some interesting experiments with a view to devising a selective method of telegraphing by means of Hertzian waves—that is, to enable any one station to communicate with any other particular one. The researches which he made seem to have been quite extended, although the distances used in most of them were only a few meters. The main element in the Marconi system is the use of wires connected with the radiator and the coherer; he determined quantitatively the effect of these wires; instead of a coherer he used a thermocell or a bolometer, by means of which he could measure the energy in a galvanometer, thus giving quantitative results. The deflections were measured for different distances between the receiver and the transmitter, and the results are given in a curve; if the radiation starts from a point it should diminish inversely as the square of the distance; if it starts from a wire infinitely long it should be inversely proportional to the distance; both of these curves are also given, showing that the experimental curve lies between these two. Another set of experiments as made with resonance; the radiator was provided with two wires of equal length, and likewise the thermocell, except that in the latter case the length of the wires as varied, the galvanometer deflection in each case being measured; in all the curves obtained, in which this deflection was shown as a function of the length of the wires of the receiver, there was a very decided maximum when the wires of the receiver were equal to those of the transmitter showing resonance; the best effect will, therefore, be obtained when the wires are of equal length; by making the wires equal a selective system may therefore be constructed, as only that receiver will respond which has the same length of wires. Marconi, however, has only one wire at each station, the other pole being grounded; researches showed that the curve in that case does not show resonance, as the deflection remained the same for different lengths of wire. The results obtained were quite different when the thermocell or bolometer were used than when they were replaced by a coherer, so that the results obtained do not apply

directly when a coherer is used; the thermocell or bolometer measured the energy received in a unit of time, but the coherer responds in proportion to the difference of potential. To investigate resonance with the use of a coherer he placed a galvanometer in the coherer circuit and found that there was no maximum for a given length of wire, but as the results were not very definite he also tried them with the spark micrometer, obtaining no maximum, but found that the spark length increased with the length of wire. He believes, therefore, that the selective system by means of resonance, in connection with the Marconi system, is not possible as long as a coherer is used for the receiver; the coherer, however, is much more sensitive. The vertical wire of Marconi often involves difficulties in its construction, while the two horizontal wires can be erected much more easily; the waves are assumed to pass out perpendicularly from the wire, and the direction of radiation will, therefore, be more favorable for the horizontal wires; the maximum is obtained only when the four end points of the wires of the receiver and transmitter form a rectangle (he may mean a square); he therefore endeavored to increase the sensitiveness of the receiver; the effect was greatly strengthened when he used several spark gaps in series at the radiator; a condenser parallel to the spark gap also increases the action; in this way he found that the action of the radiator could be increased about twenty times, and this is by no means the maximum which could be obtained; as it is a question of the transmission of energy, the use of transformers and alternating currents of appreciable power will increase the result. The bolometer is more sensitive than the thermopile, but the latter may be improved by the use of a number of cells connected as one. He increased the distance to 200 meters, and obtained satisfactory results, although the conditions were very unfavorable; with the improvements suggested he thinks that the results will be as good as those obtained with coherers. The current, however, is not sufficient to operate a relay for an ink writer; to accomplish this he proposes what he calls a "light relay," which has the same sensitiveness as a mirror galvanometer; if a beam of light from the galvanometer is thrown on a selenium cell this result could be accomplished, but he did not try it; another method would be to use ultra-violet rays reflected by the mirror galvanometer onto a spark gap in a local circuit.

WIRELESS TELEGRAPHY.—Lond. "Elec. Rev.," August 19.—A long, illustrated description of Lodge's syntonized system. The chief idea of this improved system of Hertzian telegraphy is to enable one to send messages to only one particular receiver, and this is accomplished by a system of syntonizing, so that the receiver will respond only to a particular frequency and to a sufficiently prolonged series of oscillations. There is a relay with a subsidiary circuit, which responds only to oscillations of that particular frequency, or some multiple or submultiple of it; the conductors in this relay circuit have a large capacity and are combined with a self-induction coil, the object of which is to prolong the oscillations, constituting a radiator of a definite frequency, and this renders syntonizing possible because the response depends on the fact that the total number of oscillations is very great, so that the feeble impulse is gradually strengthened according to the principle of sympathetic resonance. Methods of tuning are described and illustrated. A coherer is also described, in which a fine point is in light contact with a vibrating strip of metal; when a telephone is used the coherer restores itself without any special vibrator; moreover, a telephone is the quickest responder that can be used. He has transmitted signals over ½ mile. It appears also that the inconvenience of the long vertical conductor in the Marconi apparatus may be overcome in this way. (See American patent 609,154, issued to Oliver Lodge, August 16, 1898.)

MARCONI TELEGRAPHY.—Lond. "Elec. Rev.," August 19.—A few further particulars regarding the recent successful trial in telegraphing from the royal yacht Osborne to the Queen at Osborne House. In one case the distance was nearly 2 miles and a hill intervened, rendering optical signals impossible; while the yacht was on a cruise messages were sent to a distance of 7.5 miles.

TELEPHONY IN GREAT BRITAIN.—Lond. "Elec." and "Elec. Eng.," August 19.—A reprint of the report of the select committee on telephones; it is also discussed editorially. A reprint is begun in the Lond. "Elec. Rev.," August 19.

MINE SIGNALS. Clements. Lond. "Elec. Rev.," August 19.—An abstract of a paper read before a South African society on the various methods of signaling, with special reference to the electrical method, which is considered to be the best.

CLEVELAND.—"Elec. Rev.," August 31.—A brief, illustrated description of the new telephone exchange, which is said to be the most modern in the world

## Miscellaneous.

LIGHTNING STATISTICS.—"Elek. Zeit.," August 4.—An abstract of some statistics for Prussia during the years 1891 and 1895. For each year there are given the number of lightning bolts in large and small cities and in villages, classified into those in which the lightning produced fire and in which it did not. A table also gives the total loss by fire and the proportion caused by lightning.

LIGHTNING STATISTICS.—"Zeit. f. Elek.," August 7.—A discussion of the statistics for Steiermark and Kaernten from 1886 to 1896.

MEETING OF GERMAN ELECTRICIANS.—"Elek. Zeit.," August 4.—A verbatim report of the proceedings of the annual meeting held last June; it is chiefly of local interest, the papers themselves being published separately in that journal (and noticed under the respective headings in the "Digest"), although some of the brief discussions are given in this report these discussions seem to contain nothing of special interest. Hundhausen presented his report concerning the standard screw-thread sockets for incandescent lamps, reviewing the chief features; a more lengthy description was referred to in the "Digest" June 11 and 25. The rules and regulations were briefly discussed. In the discussion of Passavant's paper (see "Digest" July 30) the question was brought up whether the neutral wire in a three-wire system with 220 volts on each side should be grounded; Passavant claims that it should be, stating that it would be quite doubtful whether he would connect a house installation with such a system if the middle wire were not grounded; it was thought that the higher voltages would make the system safer, because a fault would develop itself quickly.

OMAHA EXHIBITION.—"West. Elec.," August 27.—A brief illustrated description of the Machinery and Electricity Building and some of the exhibits in it.

## Book Reviews.

DISTRIBUTION DE L'ENERGIE PAR COURANTS POLYPHASES. By J. Rodet, Ingénieur des Arts et Manufactures. Published by Librairie Gauthier-Villars, Paris, France. One volume, octavo; 338 pages. Illustrated. Price, 8 francs.

This work discusses completely but apparently without any new light the now generally understood elementary theory and application of polyphase currents to power transmission purposes. It takes up the subject historically and treats analytically the rotary field, the production, transmission, transformation and translation of multiphase currents, describing generators, lines, transformers, meters, etc., and closes with descriptions of various systems which have been and are in practical operation, beginning with the Lauffen-Frankfurt installation and ending with those of Mechanicville and Lyons.

"STREET RAILWAY ROADBED." By Mason D. Pratt and C. A. Alden. Street Railway Publishing Company, New York; 135 pages, illustrated. Price, $2.

This work is so far as can be ascertained the first treating particularly of this subject, the conditions of which differ so widely from those of standard steam track construction as to make a special treatise of considerable value. The experience of both of the authors in this particular field insures the reliability of the statements made. The work is largely made up of contributions of the authors to various technical papers and society proceedings during the last few years, brought up to date and properly divided under various headings. It discusses the subject briefly from an historical standpoint, and then proceeds to present in a concise way the best practice of to-day. The art of track laying is described largely from the civil engineering standpoint, the surveying of the road, the use of various curves, cross sections of rail, foundations and joints being clearly and accurately described.

## The "M" Receiver.

The "M" telephone receiver illustrated herewith is manufactured by the firm of William J. Murdock & Co., 160 Congress Street, Boston, Mass. It is claimed to be of strictly high-grade manufacture, pony type, with highly finished hard rubber case. It is a bi-polar receiver, with metal head spools mounted on a horseshoe magnet made of the best magnet steel, the magnet

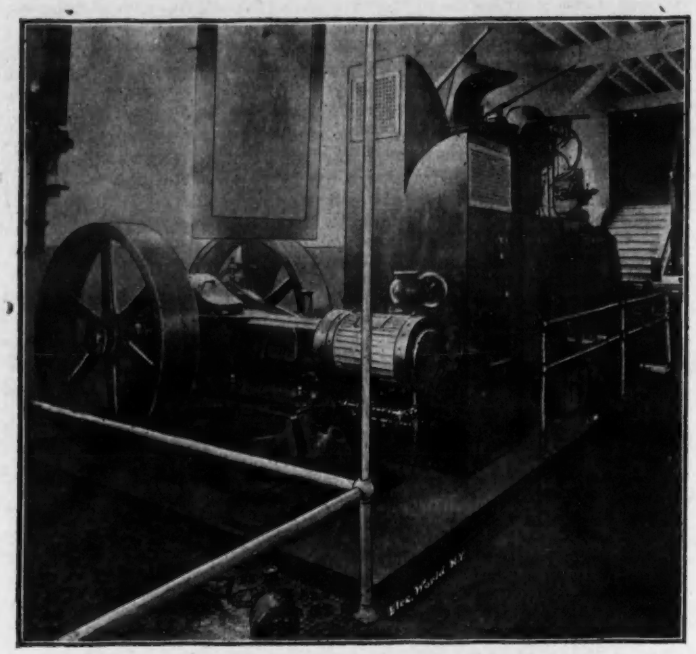
THE "M" RECEIVER.

being supported near the diaphragm so that change in temperature does not affect the adjustment. The binding posts are of new design and mounted on metal plates. The receiver weighs 12 ounces, and will operate any standard switch. For exchange work some excellent testimonials have been received for this receiver, and it is said to be giving satisfaction wherever used.

## Two of the Exhibits at the Omaha Exposition.

THE BUFFALO FORGE COMPANY.—One 12x12 high-speed horizontal engine is an interesting feature of the exhibit of the Buffalo Forge Company, beside which the company shows a complete installation of fan heating apparatus for aiding in the ventilation of large buildings by air supplied under blower pressure. The outfit is equipped with a complete arrangement of dampers for shunting the cold air around the steam heating coils, which dampers can be controlled by hand or by automatic thermostats, such an

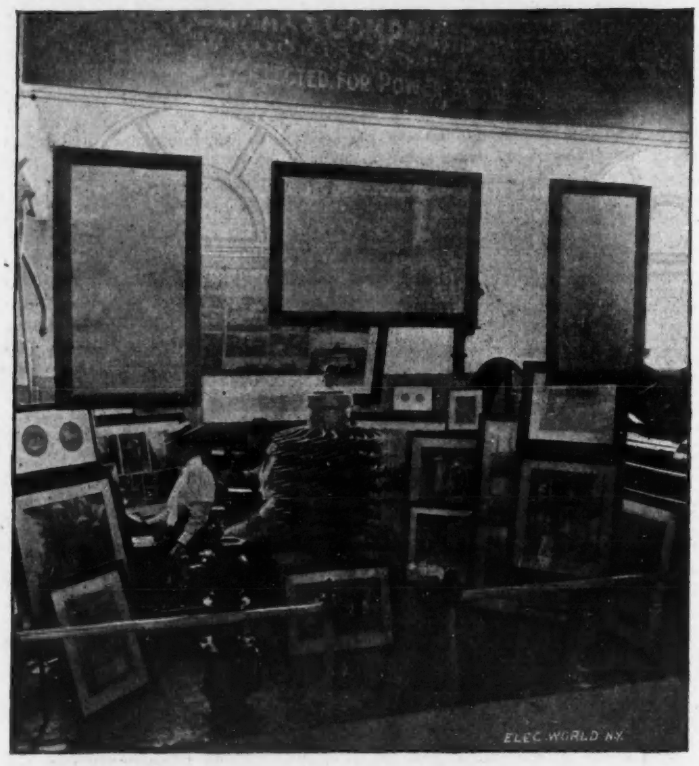
arrangement obviously giving a quicker control of the temperature than the operation of valves affecting the steam supplied to the heating coils. The exhibit contains a large number of smaller machines made by the Buffalo Forge



The Booth of the Buffalo Forge Company.

Company, one of these of interest being a 6x6 vertical engine with a shaft governor.

THE CLONBROCK STEAM BOILER COMPANY.—A section of the Morrin Climax steam boiler, showing the arrangement of the water tubes, forms a central column in the exhibit of the Clonbrock Steam Boiler Company of Brooklyn. The exhibit consists largely of views of large and small boiler-house equipments, fitted with the Morrin Climax and compound steam boilers and



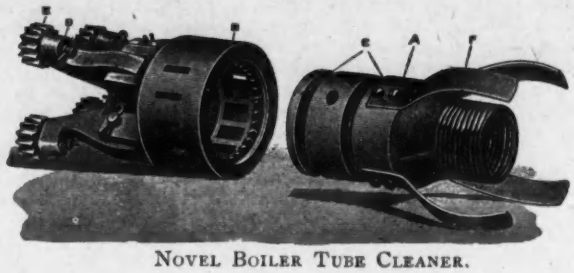
The Clonbrock Steam Boiler Company's Exhibit.

drawings of the detail arrangements of the boilers, views of trainloads of the output of the factory in Brooklyn, and other interesting scenes showing the magnitude and perfection of the company's work in the boiler field.

## Ball Bearing Boiler Tube Cleaner.

This cleaner works on the principle of a water wheel. The water entering the machine and passing out through the buckets gives a rapid motion to the revolving parts, to which brass arms are attached, having hardened steel cutters on the ends. The centrifugal force is assisted by a spring forcing the cutters against the inside of the tube, hammering, cutting and loosening the scale, which is washed out through the tube by the water as it leaves the cleaner.

The illustration shows the details of construction. *A* is a hollow brass shaft, *B* brass turbine water wheel, *C* are grooves, which are bearings for the steel



Novel Boiler Tube Cleaner.

balls, corresponding grooves being provided in the turbine *B*. *D* represents the cutter arms, of which there are four carrying the steel cutters *E*. *F* are steel springs which keep the cutter arms pressed outward.

This cleaner is the invention of H. F. Weinland, and is manufactured by the Lagonda Manufacturing Company, 690 East High Street, Springfield, Ohio.

## A New Railway Motor.

For elevated and underground railroads, as well as suburban and interurban railways, the General Electric Company has recently developed the GE-55 motor. The new motor, while differing but slightly in outward appearance from previous GE motors of similar capacity, embodies many important improvements, which, it is claimed, render it the only suitable motor for this class of work. It has already been tested on the New York, New Haven & Hartford Railroad, the Metropolitan and the Lake Street elevated roads, Chicago,

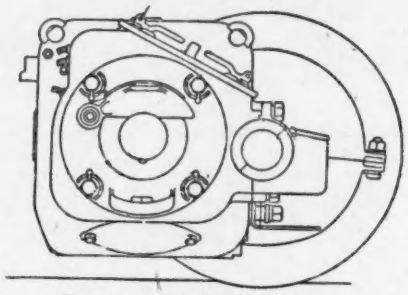
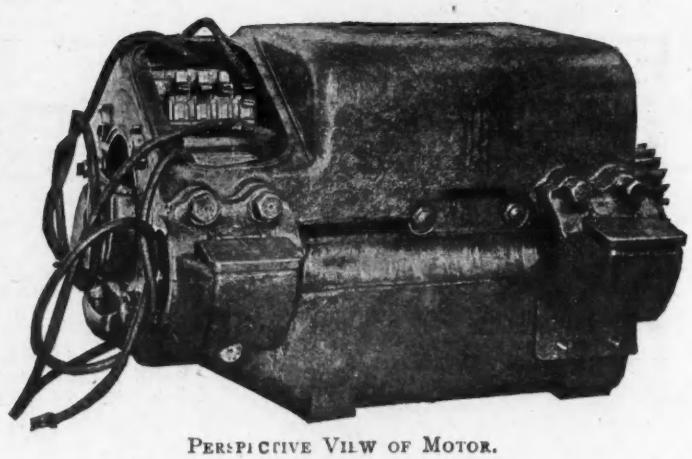


Diagram of Field Frame.

and on the locomotives of the Buffalo & Lockport Railway, under actual steam road conditions, and has proved by its success the suitability of its design and the excellence of its construction.

The magnet frame is of soft steel cast in one piece in the form of a cube with well-rounded corners. In each end is a bored-out opening large enough to allow of the removal of the armature pole pieces and field coils. Into this opening fits a frame head held in place by four bolts, and carrying the armature shaft bearing. The axle bearing caps are bolted to vertically planed surfaces on the frame. The four pole pieces are built up of soft iron laminæ, and are bolted to the top, bottom and sides of the frame, with the nuts on the outside.



Perspective View of Motor.

The four field coils are wound on metal spools held in place by laminated pole pieces. The winding is of strip copper of ample cross section, tested to a potential of 5000 volts.

The armature is of the iron-clad type, with a core built up on a composition metal spider securely keyed to the shaft. The winding is of the series drum-barrel type. Before assembling on the motor the armature is tested to withstand a potential of 3500 volts between the commutator and the core.

Each commutator is subjected to a high potential test of 5000 volts between segments and shell, and 500 volts between adjacent segments. Under all normal conditions it will run without injurious sparking.

The bearings of the armature are supported in the frame heads which ex-

tend inside the armature and commutator. They are lubricated by oil and waste, put in place through a hand hole, as with the ordinary car-box bearing. The brasses take the form of a sleeve with the sides cut away to expose the shaft to the oily waste. The commutator end bearing is 3¼ inches in diameter and 7½ inches long, and the pinion end bearing 3¾ inches in diameter and 11 inches long. A similar system of lubrication is employed with the axle bearings, which measure 5¼ inches in diameter and 10½ inches long, as with the armature shaft bearings.

All the leads are brought out through rubber bushed holes in the magnet frame, and are easily removable. The two brush holders are of cast brass, each carrying four carbon brushes, which slide in finished ways and are pressed against the commutator by independent fingers, giving a practically uniform pressure throughout the working range of the brushes. The holders are bolted to guides, which in turn are clamped to a specially designed mica insulated stud. The GE-55 motor is rated at 160 horse-power. It weights approximately 5000 pounds.

## Magnetic Blow-Out Automatic Circuit Breakers.

The inherent tendency of all circuit breaking devices to draw an arc at the last point of contact introduces a serious problem in the design of all switches and cut-out appliances. The roughening effect of the arc on the contacts destroys in a short time the usefulness of the apparatus, and as the voltage and current increase the difficulty is rapidly magnified. The advantages of the use of the magnetic blow-out wherever a direct-current electric circuit is to be opened are familiar to all users of electrical apparatus. By adding to a switch equipped with a blow-out magnet a tripping device to open the circuit at a predetermined current an automatic circuit breaker is obtained which, for convenience and reliability, may be said to surpass any other form of cut-out.

The General Electric Company manufactures four different forms of magnetic blow-out automatic circuit breakers for different classes of service. Each is rated by two numbers, the first indicating the lowest current that will automatically open the circuit, and the second number giving the maximum normal current carrying capacity, except in case of the form MM circuit breaker, when the second number indicates the maximum capacity on the basis of intermittent service common in railway work. The tripping point is adjustable in any desired current, from the lowest rating to 50 per cent. in excess of the maximum capacity, by adjusting the calibrating spring of the tripping armature.

The four different forms in which those circuit breakers are made have certain radically different features, which adapt them to the special classes of service for which they are designed. All of them may, however, be used on any direct current circuit, and, with reasonable care and attention, will operate satisfactorily under the most severe conditions.

The form MK circuit breakers are made for 150 to 8000 lamps, and are especially intended for severe service, such as on generator and feeder panels, where the circuit is subject to repeated and violent overloads. Destructive arcing is prevented by the use of supplementary contacts placed in a strong magnetic field, and arranged to break the circuit a moment after the main contact. The transfer of the arc from the main to the supplementary contacts and the immediate extinguishing action of the magnet has made possible the construction of effective circuit breakers for 8000 amperes capacity. The main contact, which is built up of leaf spring, bears upon the main contact blocks when the breaker is closed. The coil of the blow-out magnet and the secondary or plug contacts are in multiple with the main contact. Owing to the comparatively high resistance of the secondary contacts practically no current passes through them until the main contact opens; the whole current then passes through the magnet coils, and the strong magnetic field extinguishes the arc as soon as it is formed on the plug contact. The plug is not withdrawn until after the leaf contacts have left the contact blocks.

All sizes of MK circuit breakers are furnished for back connection, up to and including 800-1200 amperes capacity; they can also be furnished for front connection. Circuit breakers up to 1200-2000 amperes capacity are made when desired with an automatic locking device operated by a handle. When the circuit breaker is open it can be locked open by removing the handle, and when it is closed the handle cannot be removed. The automatic locking device is especially valuable in street railway service, as it permits circuit breakers to be left open without danger of accidental closing. All the circuit breakers in a station may be thus placed under the exclusive control of a single operator.

For power circuits and classes of work where the conditions are less severe than in regular railway service the General Electric Company manufactures the form ML circuit breaker for 100 to 800 amperes. Its principle of action is the same as that of the form MK, but the moving parts are somewhat lighter and differ slightly in general form. The form ML circuit breaker is made for both front and back connections and in two capacities: 100-500 amperes for front or back connection and 200-800 amperes for back connection only. As in the case of the form MK, the main contacts of the form ML are laminated and connected in multiple with a secondary plug with a contact, upon which the arc is broken.

The form MQ circuit breaker is made from 15 to 100-175 amperes only, and

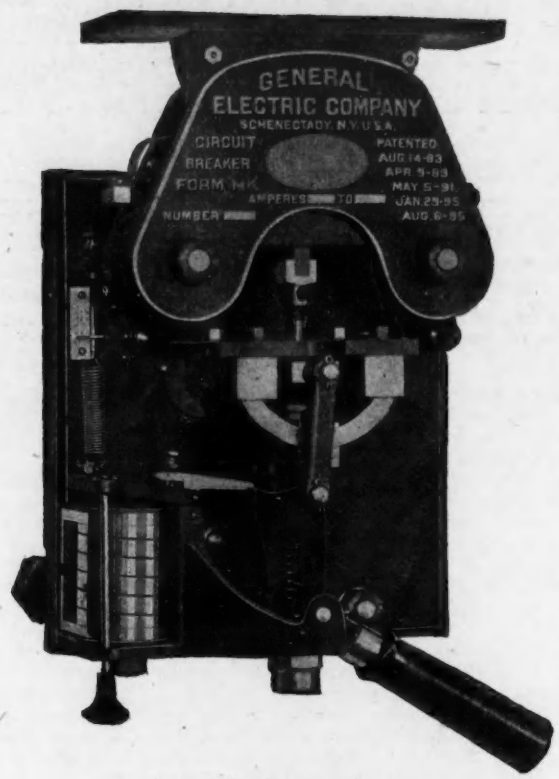
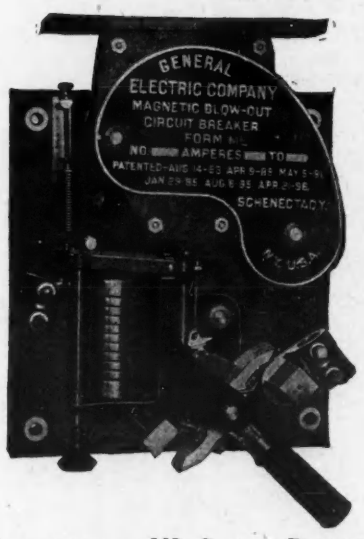
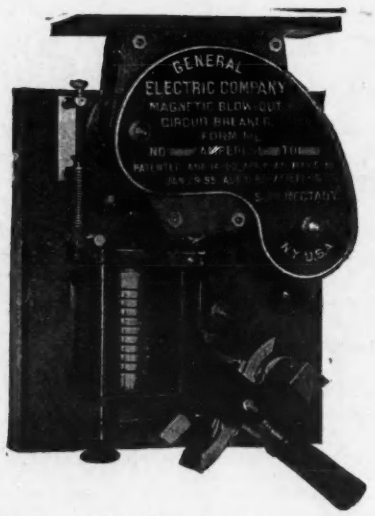



FIG. 1.—MK CIRCUIT BREAKER.

is designed especially for protection power circuits and stationary motors. In general appearance it is somewhat similar to form ML, but it has no secondary contact. The current is broken on a segmental contact similar to the contacts used in railway controllers. There is but one coil for both the tripping magnet and the magnetic blow-out. The magnetic circuit is so arranged that the arc is ruptured in its field.

The form MM circuit breaker, for 15 to 150 amperes, is designed especially for street car work, and consequently its rating is based on the intermittent currents usual in railway service. It should not be used where it will have to carry its maximum rated capacity continuously. It is intended to supersede both the old hood switch and the fuse box. The fuse box, which has heretofore been the only protective device available for motor and other car equipment appliances, has usually been placed in a more or less inaccessible position beneath the car. The blowing of fuses resulted in annoying and troublesome delays, and the form MM circuit breaker was at once received with favor, as it affords perfect protection to the apparatus, and can be instantly reset.




FIGS. 2 AND 3.—ML CIRCUIT BREAKER. FRONT AND BACK CONNECTED.

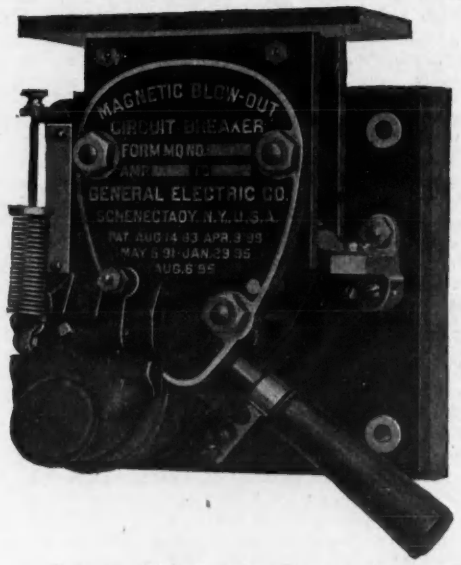
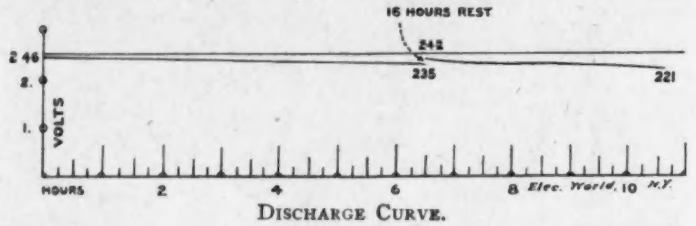



FIG. 4.—MQ CIRCUIT BREAKER.

## A New Primo-Secondary Dry Battery.

The ideal battery curve—which can, of course, never be produced from a practical battery, because, among other reasons, of the internal resistance and chemical changes incident to all batteries—is a straight line parallel to the axis of abscissæ when this represents times of discharge and the ordinates corsponding voltages. With so-called "dry" batteries, this ideal curve is even more difficult to approximate than with a fluid battery, because the chemical changes in the dry battery are localized, and the voltage runs down as the discharge continues due to want of circulation of the electrolyte. To attain an approximation to a desirable curve, changes of concentration of solutions and consequent changes of resistance have to be thoroughly understood and worked out. This has been done, it is claimed, with the "dry" cell, a discharge curve from which is shown in the accompanying illustration. The cell itself consists of a copper containing vessel partially lined with zinc, both vessel and zinc being electro-chemically amalgamated, in which condition the potential difference between the two metals is only 0.03 volt in an acid solution, as against 1.3 volts for ordinary amalgamation of copper and zinc electrodes. Within this vessel is contained the absorbent and the positive electrode, which is of some-




Discharge Curve.

what peculiar construction, and is the subject matter of numerous letters patent, and will be later described in these columns in wider applications. In the small cell from which the accompanying curve was taken the positive electrode weighs a little less than 2 ounces; therefore the ampere-hour capacity is more than one ampere-hour to the ounce of complete positive electrode with its lug, etc.—a remarkably high figure. For small cells—that is, up to sizes of 3 inches diameter by 6 inches height—the cylindrical form has been adopted, for the advantages obtained therefrom of mechanical strength and the absence of plate supports and separators. The cell for which the working curve is given is 1½ inches in diameter and 3 inches in height, an inch being allowed for sealing, air space, and to allow room for liquid that might be driven out of the absorbent if the cell be overcharged. This size of cell has a mean electrical capacity—between the e. m. f. of 2.46 volts initial and 2.21 volts final in discharge, a drop of 55 to 60 per cent. of that usually allowed—of 2.14 ampere hours, or 5.05 watt hours, the mean e. m. f. being 2.36 volts, at a current rate of one-tenth of this normal discharge. The cell weighing 5 ounces (avoirdupois) complete, with connections, this corresponds to 16.16 watt hours per pound of complete battery. Dr. Kennelly in a recent paper read before the American Institute of Electrical Engineers stated that the best storage batteries hitherto constructed, and these fluid batteries, gave only five to six watt hours per pound, so that the battery here described shows considerable advance in this direction. One of the claims for this battery is that there is nothing "secret" about it—the results are obtained by skillful manipulation and thorough knowledge of the materials employed, as attained by a long series of experiments and actual trials. These batteries are perfectly dry, and are susceptible of high and quick charging rates, with efficiency of about 80 per cent. Dr. Leonard Paget, well known as a collaborator of the late M. Planté and as an electrical engineer, is the inventor. The tests, as recorded, were made on standard Weston instruments by Mr. S. Barr Devlin, of the College of the City of New York, and the batteries are being put upon the market by the Reliance Lamp Electric Company, of 131 Liberty Street, of the same city.

## India Mica.

Although mica is extensively used in the electrical industries comparatively few persons know much about its nature, how it is mined, etc.

Some interesting facts regarding the mining of mica in India are given in a neatly gotten up pamphlet published by Messrs. Eugene Munsell & Co., 218 Water Street, New York City. The mica mines of India are in the interior of the country and very inaccessible. The "Abruker Mine," it is stated, produces the finest mica that has ever been mined, both for lamination and color. It has been sunk about 200 feet, following the pitch of the vein, and all this mica and refuse has been raised and carried away by the natives. No machinery of any kind except drill and hammers is used in their mining operations. The refuse and the mica are placed in baskets, each holding about 10 pounds, the baskets being passed up from hand to hand by women who stand in a line on ladders. The contents of the baskets are deposited at the top, and the baskets are returned down the ladder in the same manner as they went up, but by another line of women. Water is taken out of the mines by means of jugs. It is supposed that this method of operation has been carried on for many hundreds of years, except that there is more care to protect the miners.

After the crude mica is taken from the mines it is first roughly trimmed and then sorted into different grades, according to sizes and quality. It is then taken to the mica workers, who split it up and scribe out the size for it to be cut into by the shearers, the cut pieces then being cleaned, weighed and packed ready for shipment. The mica is then transported to general warehouses in baskets on the backs of bullocks and in bullock carts. In this way it is carried hundreds of miles to shipping points at a speed of about 10 miles a day.

The mica can be split down to .0003 of an inch in thickness. Being both fireproof and transparent it is very useful for many purposes in the arts besides being an excellent insulator. Mr. Franklin Brooks, of the firm of Eugene Munsell & Co., is said to be the only American mica miner who has visited the India mines, and what he saw there was an interesting revelation of antiquity, both from an engineer's and miner's point of view.

## Portable X-Ray Outfit on the Hospital Ship "Solace."

At the beginning of the Santiago campaign the necessity of equipping the hospital ships with efficient and powerful X-ray apparatus was immediately perceived by the Surgeon-General of the United States Navy, who realized the importance of installing apparatus which should be powerful and so simple in construction and operation that it could be properly handled by any ordinary mechanic. An order was placed with the Edison Manufacturing Company for one of its latest portable cabinet X-ray outfits, to be placed on board the United States naval hospital ship "Solace," and the entire apparatus was placed in position ready for use within forty-eight hours after the placing of the order. A brief description of this apparatus, which is illustrated below, may be of interest to our readers.

The cabinet, which is made of polished quartered oak, of massive construction, occupies a floor space of 2 feet 8 inches by 1 foot 8 inches, and is furnished with four wrought-iron Ls screwed onto the base of the same, by which it can be rigidly fastened to the deck. The Edison coil, which is mounted on top of the cabinet, is also furnished with brass Ls and strips to hold it firmly

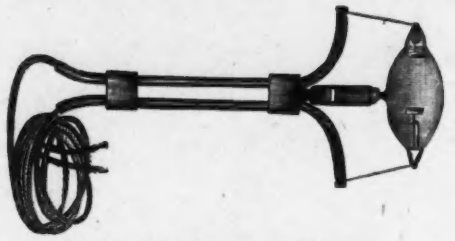


Fig. 2.—Focus Tube Holder.

in position, and the base of the adjustable focus tube stand is similarly screwed to the top of the cabinet.

The distinctive feature of the Edison X-ray outfits is that there is no vibrator on the induction coil, its place being taken by the instantaneous air-break wheel device shown in the bottom part of the cabinet. This device consists of two tooth-wheels mounted on the same shaft. The projections or teeth make contact with two flat brushes, which bear on the outer peripheries, and by which the current is brought in and led out again. These wheels are rotated at a very high speed, by a small direct-current motor, which also runs a pressure blower. The air blast from this blower enters a bifurcated tube, and is conducted to two flat nozzles immediately over the contact brushes. The spark formed at the brushes, when the coil is energized, is instantaneously blown out by the air blast at the moment of formation.

The controlling rheostat shown in the upper shelf of the cabinet is used to vary the current in the primary of the coil, and the lever arm of the rheostat is connected to the extension rod passing through the side of the cabinet so that the doors of the cabinet can be closed and the rheostat actuated by means of this extension rod, which is shown on the right-hand side of the illustration. The main switch is shown on the left-hand side of the cabinet, near the top, and the cut outs directly underneath the same. The apparatus is entirely protected when not in use. In cases where the patient is so seriously wounded

Fig. 1.—Portable X-Ray Outfit.

that it is necessary for him to maintain a reclining position, the focus tube is attached to the portable focus tube holder, shown in Fig. 2, and the focus tube stand is dispensed with.

The work that has already been done has shown the great value of such an apparatus in warfare, and the necessity of equipping all naval, marine and military hospitals with a device of this kind. One great advantage possessed by it is that it can be moved from place to place without delay.

# NEWS OF THE WEEK

## Financial Intelligence.

THE BROOKLYN RAPID TRANSIT RAILROAD COMPANY reports gross earnings for August of $563,257, an increase of $85,857, as compared with the same month last year.

## Special Correspondence.

### NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, September 5, 1898.

THE AUXILIARY CRUISER "YANKEE," whose officers and crew include several electrical engineers, after an active and honorable career in the naval operations against Spanish dominion in the West Indies has returned to the United States, and is now at the League Island Navy Yard, Philadelphia. The "Yankee's" crew constitutes the New York Naval Reserve, and they acquitted themselves during the war in a truly heroic manner. The vessel was a participant in some of the important naval engagements in Cuban waters and her crew return to private life with a large measure of honor and glory to their credit. The ship's "company" has been mustered out of Uncle Sam's service, and they returned to New York on Friday last. They marched up Broadway to their armory at the foot of East Twenty-eighth Street —the old wooden warship "New Hampshire." They were in fine spirits and glad to get home again after their exciting experience of the past few months. Lieut. S. Dana Greene, assistant general manager of the General Electric Company, was the second officer in command of the "Yankee."

THE PACIFIC CABLE.—A meeting of the directors of the Pacific Cable Company was held in the office of J. P. Morgan & Co. in this city on September 1, at which important steps were taken toward carrying out the purpose for which the company was organized. The company's plans provide for the laying of a cable from San Francisco to Hawaii, with branches to Japan and Australia. According to the "Herald," at the meeting of September 1 it was decided to add to this a duplicate system, starting at San Francisco and running up the Pacific Coast to Sitka, Alaska, touching again at the Aleutian Islands and connecting with the other line in Japan. It was decided to begin work at once on surveys for this line. Mr. James A. Scrymser, president of the company, has started for Vancouver, whence he will sail on September 12 1or Japan. The object of his trip, it is stated, is to make contracts with the Japanese Government and obtain from it a subsidy of at least $100,000, for which in return the Government of Japan will have free telegraph privileges for twenty years. The cost of the Sitka and Aleutian Islands branch cannot be determined until surveys are made, but the route connecting the Hawaiian Islands and the spurs to Australia and Japan, will, it is stated, cost about $10,000,000. The work will involve the laying of about 10,000 miles of cable. The Pacific Cable Company was organized under the laws of New York State in December, 1896, its authorized capital being $10,000,000.

MR. GEORGE R. BIDWELL, collector of customs at the port of New York, has been instructed by the Treasury Department at Washington to appeal from the decision of the Board of General Appraisers in assessing electric light carbons at 35 per cent. ad valorem. The department holds that they are subject to duty at the rate of 90 cents per hundred, which was the rate originally assessed by the local appraiser under the tariff act of July 24, 1897. It will be remembered that when the tariff act became operative the appraiser contended that electric light carbons were dutiable under paragraph 98, at the rate of 90 cents per hundred, while the importers claimed that they came under the head of paragraph 97, which provides a duty of 35 per cent. ad valorem on "articles composed of carbon." When the law went into effect the importers of carbons brought these goods into the country in lengths of 24, 29 and 36 inches, afterwards cutting them into proper lengths for use. The Treasury officials regarded this as an evasion of the tariff act, and directed the collector at New York to charge at the rate of 90 cents per hundred for carbons of commercial length, so that sticks 36 inches in length would be chargeable as consisting of three carbons of 12 inches each, other lengths to be charged for in proportion. The matter was referred to the Board of General Appraisers, who, represented by Judge Somerville, decided, in brief, that these goods come under the head of paragraph 97, and are therefore dutiable at the rate of 35 per cent. ad valorem, as "articles composed of carbon." An appeal from this decision was ordered by the Washington authorities, as above stated.

THE FUTURE OF CUBA AND PORTO RICO.—The opening up of Cuba and Porto Rico to American enterprise, which is one of the most important results of the war with Spain, will no doubt offer a rare and excellent opportunity for the utilization of electricity in every known form. As the islands become Americanized electric railways will become a very important factor in their development; electric light will become more extensively used than it is at present, and the telephone will play an important part in the advance of these insular territories. The transmission of electrical power will also find a broad field for application, and in many ways electricity will aid very largely in turning to good account every possibility inherent in these valuable possessions. One large electrical concern, we understand, has already developed plans for the application of electrical power on sugar plantations, while others in the same line of industry are actively at work laying plans to share in the large business that is promised. Experts and agents are preparing to visit the various cities where up-to-date electrical appliances will be needed. It is stated that Col. Eugene Griffin, of the First Regiment of Engineers, who, with his regiment, is now in Porto Rico, will make a special study of the needs of that country in the matter of electrical improvements in the interest of the electrical company with which he is connected. As to the Philippines nothing can yet be said with certainty, as the future possession and government of the islands are problematical. There exists a belief among some, however, that American enterprise will, in any event, be given free rein in that far-off country, and so strong was this belief in the minds of three or four young electrical engineers in this city that they enlisted in the engineer regiment. which was sent to Manilla, in order that they might be on the ground when the doors of enterprise and prosperity were opened.

### NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 630 Atlantic Ave.,
BOSTON, Mass., September 1, 1898.

BOSTON'S subway system is now entirely completed, and was finally inspected by the Transit Commission this week. It is expected that it will be opened to the public next Monday, September 5.

MR. W. A. BENT is now the treasurer of the Bates Machine Company, Boston, succeeding Mr. H. N. Bates. Mr. Bent has been connected with the Lowell (Mass.) Electric Light Company for a number of years, and enters upon his duties with a full knowledge of how to discharge them.

THE PAGE ELECTRIC COMPANY, Worcester, Mass., is now nicely housed in its new quarters at 24 Pearl Street, immediately adjoining its old quarters, which it occupied for so many years, and has also recently succeeded to the business of the Central Electric Company. The Page Company is well and favorably known to the electrical trade, having been established in 1883 and incorporated in 1897. It has always done a large supply and construction business, and since it has been under the management of Mr. J. P. Coghlin its business has materially increased.

MR. H. N. BATES has resigned his position as treasurer of the Bates Machine Company, Boston, which position he held for so long. Mr. Bates' resignation is due to the fact that he will hereafter be identified with the Continental Construction Company, a new Boston corporation organized for the purpose of constructing street railways, and which, it is said, will, with ample capital and facilities, become an important factor in this business. The company is certainly fortunate in having secured the services of Mr. Bates, who is known to everybody in the electric lighting and power fields throughout the country.

THE BIBBER-WHITE COMPANY'S offices and salesrooms, 49 Federal Street, Boston, have recently been materially enlarged and changed. The increase in its railway supply business has necessitated additional facilities, and a room almost equal to its original floor space has been secured in the adjoining building. This space is used largely to store railway supplies. The well-known manager of this department, Mr. Herbert W. Smith, has by his indomitable persistence built up a remarkably large trade in a short time, while the well-known executive ability and energy of President Charles E. Bibber, the "Little Giant," as he is termed by his numerous friends and acquaintances, is always telling for business. Treasurer Brown, General Manager Thomas C. Bibber and David W. Dunn are also important factors in the conduct of the business of this company.

THE SWETT & LEWIS COMPANY, Boston, dealers in X-ray apparatus, recently secured the contract for furnishing the X-ray outfit for the hospital ship "Bay State." A 10-inch coil of special design was furnished to run from storage batteries, the batteries being charged from the dynamo of the ship. Six of the type W tubes, manufactured by the Swett & Lewis Company, as well as a large fluoroscope, were furnished. The tube stand was particularly adapted to the work. The main part of the stand and base is of iron, and very heavy; the arms holding the tube and wires are of fibre, with an adjustable wooden clamp for the tube. With this stand it is possible to hold the tube in any position from within a few inches of the floor to 8 feet above it. The ship also carries about a gross of X-ray plates and a full developing and printing outfit. We understand that this company is putting out a large number of its static machines and has several large hospital orders on hand.

A UNIQUE LIGHTING CONTRACT.—Mayor Quincy has submitted to the Board of Aldermen a message and special report on the subject of street lighting in Boston after February 20, 1899. The communication included a copy of the new contract with the Boston Electric Light Company to light the streets for a period of ten years after the date mentioned, which contract contains some unique provisions. It provides for a board of arbitration to settle disputes between the parties, and for a change of rates when conditions are favorable. The existing prices for the present number of lights will be charged to begin with, but a material reduction in the cost of lights is provided for on a sliding scale as the number increases. There is a further provision enabling the city to have the price revised by arbitration every two and a half years, so that it shall not yield to the company, after it has met that portion of its operating expenses and depreciation account properly chargeable to its public lighting business, more than the actual return, not exceeding 6 per cent. in any event, which it pays upon the capital invested in its business, whether raised from the sale of capital stock or of bonds; if the company pays a larger dividend than 6 per cent. during the term of this agreement it will therefore have to come entirely from its profits on private

lighting. The difficulty in connection with arbitration of fairly apportioning the expenses of the company between its private and public business has been met by providing for the measurement, under the supervision of the city engineer, of the electrical output for private and public business. On the whole this is thought to be the fairest method of determining the proportion of capital invested, operating expenses and depreciation which should be charged to the public lighting account. The contract further provides that the lighting company shall substitute enclosed arc lamps for the open arcs now in use and for the removal of the iron poles and the substitution of wooden ones. The prices for lighting are as follows: For not less than 2365 nor more than 2749, 35 cents per night, $127.75 per year; for not less than 2750 nor more than 2999, 34½ cents per night, $125.92 per year; for not less than 3000 nor more than 3249, 34 cents per night, $124.10 per pear; for not less than 3250 nor more than 3499, 33½ cents per night, $122.27 per year; for not less than 3500 nor more than 3749, 33 cents per night, $120.45 per year; for not less than 4000 nor more than 3999, 32½ cents per night, $118.62 per year; for not less than 4000 nor more than 4249, 32 cents per night, $116.80 per year; for not less than 4250 nor more than 4499, 31½ cents per night, $114.97 per year; for not less than 4500 nor more than 4749, 31 cents per night, $113.15 per year; for not less than 4750 nor more than 4999, 30½ cents per night, $111.32 per year; for not less than 5000, 30 cents per night, $100.50 per year. Under the present contract the city pays 35 cents per light per night.

## Canadian Notes.

OTTAWA, Ont., September 1, 1898.

MR. C. E. GREEN, who comes from Rochester, N. Y., but who has spent several years in Toronto, Ont., claims to have discovered a mode of producing electricity for light and power purposes without the aid of either fuel or water. He declares that he can produce unlimited quantities at Toronto at a cost to consumers far below one-half that at present involved in the production of electric energy. The secret of this miracle working is, he says, a very simple affair, but he does not propose to give any clue to it just now. In a few weeks he expects to be able to place the scheme on a working basis.

NEW WAGE SCHEDULE FOR MOTORMEN.—The new rate of wages put into force by the Ottawa Electric Railway Company is as follows: All men who have been in the employ of the company three years and over will receive 15 cents per hour; those under three years and over two will receive 14 2-7 cents per hour; those under two years and over two months, 14 cents per hour. This schedule only applies to all men at present in the employ of the company. Those employed in the future will be graded at 13 cents per hour for the first year, 14 cents for the second and third years, and 15 cents thereafter. Ten hours are to constitute a day's work.

THE CATARACT POWER COMPANY, of Hamilton, Ont., formed its first connection with that city last week, sending in 22,000 volts over the wires from its water-power canal near Thorold, Ont., thus demonstrating its ability to convey electrical power a distance of 40 miles. The plant to do this cost about $500,000. A large driving motor of 40 horse-power was used in the test, and 200 incandescent lamps had been arranged in the form of a shield, which was illuminated. It is expected the company will supply the Hamilton Electric Light & Power Company with power for its dynamos by October 1. The voltage will be reduced by transformation to 2000 volts.

THE SHAWINIGAN WATER & POWER COMPANY, which proposes to utilize Shawinigan Falls on the St. Maurice River, in the Province of Quebec, 17 miles from the town of Three Rivers, Que., has decided to install at once a plant capable of developing 100,000 horse-power. The plans have been prepared by Messrs. T. Pringle & Son, of Montreal, assisted as consulting engineer by Mr. W. C. Johnson, of Niagara Falls, N. Y., and the company is now calling for tenders. It is understood that power will be sold at Three Rivers cheaper than it can be obtained at any other port in the world reached by ocean-going vessels, and also at the Falls at a proportionately low figure. A strong company has been formed, with the following directorate: Messrs. A. F. Gault, Thomas McDougall, Hon. L. J. Forget, P. N. Greenshields, all of Montreal, and John Joyce, H. H. Melville and J. E. Aldred, of Boston, Mass. The company is confident that the advantages which it can offer to manufacturers on a large scale are so great that it will mark an era in the industrial development of the Province of Quebec.

## English Notes.

(From Our Own Correspondent.)

LONDON, August 24, 1898.

MR. PREECE.—A rumor has been spread that Mr. Preece, who reaches the age limit next year and would in the ordinary course retire from the service of the Post Office, has been requested by the Duke of Norfolk to continue for a further period in office, in order to study the development of a state telephone system. Although there would be nothing surprising if this rumor were true, I hear from official sources that it is absolutely without foundation.

EXHIBITION OF MOTOR CARS.—At a show of auto-cars at the Agricultural Hall, Islington, London, now being held, there is quite a substantial number of electrically propelled vehicles. Among the exhibits are cabs by Le Chev. Jeantaud, of Paris; the American designed phaeton of Mr. A. L. Riker, of Brooklyn, N. Y., and the cabs of the Headland's Patent Storage Battery Company. Mr. Carl Oppermann, of London, shows a neat "Victoria" carriage brought out by him. The total weight is 28 cwt., of which the accumulators weigh 12 cwt. These latter are of the Headland type, and consist of forty-two cells, each cell weighing, complete, 311 pounds, and having a capacity of 150 ampere-hours at a discharge rate of twenty-five amperes. The average working current is twenty-three amperes, though on a 14 per cent. grade this rises to seventy-five amperes. The cells all go into a box measuring about 10 or 12 inches deep by 33 inches by 42 inches. This case is suspended from springs under the body of the carriage. The motor is a bi-polar series wound machine of 3 rated horse-power. The field windings on the two legs can be connected in series, or parallel with one another. No resistances are used for controlling, but three steps are provided; the first step is made by the motor fields being put in series and the cells divided into two parallels of twenty-one cells in series. The second step is provided by the cells being all in series and the motor fields also in series, while the third step is provided by the cells being put in series and the motor fields connected in parallel with each other. At 1650 revolutions of the motor per minute the car makes 9 miles an hour. The wheels are 3 feet 6 inches in diameter, and provided with solid rubber tires. The Riker phaeton on show is also provided with the Headland cells, but does not limit itself to any particular type of battery. The Headland Company shows a neat cab, with the motor driving onto the front wheels, its former design using the rear wheels as the drivers. No resistance is used or alteration in the motor connection is made in regulating the speed of this cab, the cells being merely split up into four sets of cells and various combinations made. The Fulmen Accumulator Company, of France, makes an interesting exhibit of its cells, and the Electrical Cab Company, whose cabs are daily in use in London, shows its latest design.

THE BRADFORD ELECTRIC TRAMWAYS.—There are several lines of electric tramway now being built in Bradford, and the first of these was opened recently. The length of this line is 1 mile 1517 yards. There are 1727 yards of single track and 1575 yards of double track line. The total rise is 326 feet and the steepest gradient 1 in 16, for a distance of 70 yards. The track construction is the same as that of the old steam tramways in the town, 103-pound rails being used with heavy fish plates, and an extra plate fastened under the flange of all the joints. Cast-steel points and crossings are used, and a special feature is a short section of drain rail every few hundred feet. The track is bonded with No. 0000 B. & S. Crown bonds, fastened under the web of the rail under the fish plates, and only about 6 inches long. Cross bonds are also used. The power for operating the tramways is being supplied from the Bradford Corporation lighting station, the generators being arranged so that they may be used either for lighting or power work. The tramway switchboard is, of course, entirely independent of the lighting switchboard. It contains four generator panels of the usual type and two feeder panels, each arranged for two feeder circuits. A seventh panel is arranged with the requisite testing instruments, according to the Board of Trade requirements, and is placed between the other two. The switchboard has been installed by Mr. Robert W. Blackwell, of London, the line and cars having been supplied by the Westinghouse Company. Centre poles and side poles are both used to support the trolley line, and are 31 feet long, buried 6 feet deep and set in concrete. They are fitted with cast-iron joint rings, bases and tops, and wrought-iron ornamental brackets, and they present a very handsome appearance. The line is divided into half-mile sections, in accordance with the Board of Trade requirements, each section being connected to feeders through a junction box in which are the fuses controlling that section of the line. Guard wires, also divided into sections, are erected wherever the line is crossed by telegraph wires. There are no overhead frogs, the trolley wire being double throughout the entire length of the line. Copper trolley wire is used, the guard wires are of steel cables and the feeders are armored and all underground. At present sixteen cars have been delivered—seven for the line just opened and nine for another, which will in all probability be opened next month. The car bodies, made by the Brush Electrical Engineering Company, are roomy and comfortable, seating twenty-two inside and twenty-three outside. Standard "Peckham" cantilever trucks, fitted with 30-inch wheels, are used. The motors are Westinghouse No. 49 slow-speed single-reduction railway motors. Standard Westinghouse controllers are used, and each car is provided with an automatic switch and cut out with magnetic release.

# General News.

## New Incorporations.

THE ALTON ELECTRIC LIGHT & POWER COMPANY has been incorporated at Concord, N. H.

THE WISCONSIN STORAGE ELECTRIC & WATER COMPANY, Sheboygan, Wis., has been incorporated with a capital stock of $25,000.

THE GORDON TELEPHONE COMPANY, Chester, Ill., has been formed with a capital stock of $5000. Among the incorporators are A. G. Gordon, E. R. Gordon and C. Gordon.

THE JEFFERSON ELECTRIC LIGHT COMPANY, Chicago, Ill., has been incorporated with a capital stock of $50,000. The incorporators are M. A. Fort, H. Ferguson and W. H. Copeland.

THE STANDARD TELEPHONE COMPANY OF MISSOURI, Kansas City, Mo., has been incorporated with a capital stock of $300,000. T. T. Crittenden is counsel and S. J. Angew secretary of the new company.

THE DUNMORE ELECTRIC LIGHT COMPANY, Dunmore, Pa., has been incorporated with a capital stock of $50,000. The incorporators are J. E. Watkins, A. T. Irwin, A. B. Dunning, J. H. Fellows and J. C. Vaughn.

THE JOHN KAMMER COMPANY, Chicago, Ill., has been incorporated with a capital stock of $50,000, for the purpose of manufacturing electrical appliances. Among those interested are John Kammer, Joseph Staab and William J. Rhode.

THE SILOAM SPRINGS TELEPHONE COMPANY, Clayton, Ill., has been formed with a capital stock of $1500. The incorporators are G. L. Thompson, John Padgett, John W. Buttz, George Waner, John R. Wallace, B. A. Curry and W. H. Breckenridge.

THE WETMORE ELECTRIC COMPANY has been incorporated at Albany, N. Y., with a capital stock of $40,000. The directors are George W. Pulver, of Syracuse, N. Y.; Jacob Strife and Oliver P. Hedden, of Lowville, and Thomas Glenn, of Croghan.

THE MASON COUNTY TELEPHONE COMPANY, Macon, Mo., has been formed by H. H. Abbott, S. H. Nash, R. B. Turner, C. W. Davidson, John W. Wisdom, J. T. Rogers, George E. Maxey, D. A. and Joseph Nickell, all of Macon County. The capital stock of the new company is $2700.

THE NORTHERN TRACTION COMPANY, Michigan City, Ind., has been formed for the purpose of building an electric railway from Michigan City to La Porte. The capital stock of the company is $150,000. Among those interested are John W. Lovett, W. W. Huffman, W. E. and C. W. Hooven and George Nichol.

THE GAINESVILLE PARK STREET RAILWAY COMPANY, Gainesville, Tex., has been formed with a capital stock of $100,000, for the purpose of acquiring the right of way and the construction, operation and maintenance of a system of street railways within and near the city of Gainesville. The incorporators are J. M. Lindsay, Lewis Lindsay, Henry Lindsay, George Lindsay and H. E. Elbridge.

## THE TELEGRAPH AND TELEPHONE.

OLDTOWN, ME.—The New England Telephone & Telegraph Company is extending its lines from this city to Lincoln.

SAGINAW, MICH.—The new telephone line constructed by the Valley Telephone Company between Flint and Saginaw is now in full operation.

FREMONT, OHIO.—The Home Telephone Company, of Fremont, has been granted a franchise to construct and operate a telephone system and exchange in this city.

MENOMINEE, MICH.—It now looks reasonably certain that the long-distance telephone extension to Escanaba, Iron Mountain and the Marquette iron range will materialize.

CLINTON, IA.—The Tri-City Telephone Company is putting in a new 600-drop switchboard, and is making other changes which are made necessary by a contemplated extension of its business.

MORRIS, ILL.—The Chicago Telephone Company is extending its Braidwood line to Gardner, Coal City, Braceville and Carbon Hill, which will give Morris a connection with these towns.

GALENA, KAN.—The Galena-Kansas Telephone Company will have poles on the ground about September 1 for a subscribers' line from Galena to Girard, via Columbus, Weir City and Cherokee, Kan.

BROOKFIELD, MO.—Mr. W. H. Alley has sold the Brookfield Telephone exchange to the Western Telephone Company, of which Judge H. G. Orton, of Princeton, Mercer County, Mo., is president.

PORT BYRON, ILL.—The Central Union Telephone Company is making arrangements for extending its line directly from Port Byron to Hillsdale. It has secured the right of way for most of the distance.

JOLIET, ILL.—By a unanimous vote the City Council of Joliet has refused to grant an ordinance to the proposed new telephone company. The persons seeking the franchise are John W. Arnold, E. R. Conklin and Thomas F. Ryan.

MANKATO, MINN.—Arrangements are under way to connect this city with Blue Earth City by telephone. The officers of the companies in both cities have had a conference concerning the matter, and it is believed that the connections will be made in a short time.

TACOMA, WASH.—The Sunset Telephone Company has reached Yelm with its new Tacoma-San Francisco line. The work of stretching the wires is progressing rapidly at this end of the line, and it is expected but six weeks' more time will be needed to reach Portland.

SAULT STE. MARIE, MICH.—The Michigan Telephone Company will soon install several automatic pay stations in the city for the benefit of non-subscribers. The charge will be 5 cents for a local message and 10 cents for people desiring communication with the Canadian Soo.

TERRE HAUTE, IND.—Final steps in the organization of the People's Telephone Company were taken at a recent meeting of the directors. A loan of $75,000 was negotiated, and the line will be built at once. W. R. McKeen, M. F. Hoberg, W. E. McLean and B. F. Havens are the directors.

DES MOINES, IA.—A large party of workmen have been at work for the Iowa Telephone Company the past few days building another wire between Des Moines and Indianola. The new circuit will complete the metallic circuit between Des Moines and Oskaloosa and the towns in the eastern part of the State, reaching as far as Davenport.

FORT DODGE, IA.—The stockholders of the Fort Dodge Telephone Company met and perfected the organization of the company. The officers chosen were: F. E. Seymour, president; C. D. Koch, vice-president; R. O. Green, secretary, and G. C. Kettering, treasurer. The company will proceed at once to the erection of its plant and to the completion of the details of its business.

FLUSHING, N. Y.—The number of subscribers to the local telephone exchange, which includes Flushing, College Point, Whitestone, Bayside, Little Neck, etc., has increased to upward of 200, making too much work for a single operator. In order to relieve this condition the management has decided to establish a new exchange for College Point and Whitestone. The new office will be located at College Point and will be connected with trunk lines, etc.

FLORENCE, ALA.—The Lawrence Telephone Company has been organized at Iron City, Tenn. The company will build lines connecting neighboring towns with Florence and Columbia, giving Florence and Iron City long-distance connection through Nashville. The Southern Bell Company guarantees the Lawrence Company 10 per cent. on its investment, and will cancel the stock at the option of the stockholders. The officers of the new company are: J. W. Becket, president and treasurer; John A. Pruitt, secretary and general manager.

CLEVELAND, OHIO.—A company headed by Henry A. Everett, a well-known capitalist of this city, has been organized and incorporated to cover Ohio with a cheap rate long distance telephone system. It will be known as the Union Suburban Telephone & Telegraph Company. The incorporators are H. A. Everett, M. W. Moore, J. B. Hanna, James B. Hoge, Charles W. Wasson, Frederick Storm and H. B. McGraw. The capital stock is $1,000,000. It is proposed to establish telegraph and telephone lines all over Ohio and into other States. Mr. Everett is largely interested in the Home Telephone Company, which is putting in an extensive underground system in Cleveland to compete with the Bell Telephone Company.

FORT WAYNE, IND.—The local telephone fight has developed another phase in the efforts of the Central Union Company to stifle the Independent Home Company. The four local managers of the express companies, the Adams, American, United States and National, called on President Beers and gave him sixty days' notice of their intention to remove the Home 'phones from their offices unless it be furnished without cost. They explained to Mr. Beers that the announcement was obnoxious to them, but they had received orders to give him the notice and must do so. Mr. Beers said he realized that they had a disagreeable piece of work to do, and that while he had nothing against them personally, from henceforth he was against them as agents of the companies. The Home service, he said, would not be furnished free. What the result will be is not yet known. There are 123 independent companies in the State, and the fight may be carried to the next Legislature, which will be asked to pass an anti-trust law that has an edge on it. The alliance of the express companies, not only with each other, but with a powerful financial concern, such as the Bell Telephone Company, is plainly evident from the developments of the year. It is probable that the State Telephone Association will soon have a meeting to discuss the situation.

## ELECTRIC LIGHT AND POWER.

QUINCY, ILL.—Edwin L. Barr and W. H. Schott, two Chicago capitalists, have been in the city for several days with the view of purchasing the Empire Electric Light & Power Company's plant.

GRAND RAPIDS, MICH.—A special meeting of the Board of Public Works adopted the new specifications for the lighting plant, drawn by the consulting engineers, Nagle & Ball. Clerk Twamley was directed to advertise for bids to be received up to September 20.

SHELBYVILLE, ILL.—The Trout Brothers electric light plant, which has been in the hands of a receiver, was sold to the Shelbyville Water & Light Company at private sale for $9300. The purchase gives the latter company a monopoly of the water and light supply of the town.

NEWPORT, PA.—A charter has been granted at the State department for the Perry Electric Light, Heat & Power Company, of Newport, with $13,000 capital. Its incorporators are A. D. Van Dyke and S. S. Leiby, Marysville; J. K. Van Dyke and John H. Smith, Philadelphia, and J. S. Leiby, Newport.

ELGIN, ILL.—The trustees of West Chicago have purchased the electric light plant for $18,000, agreeing to pay $3,000 annually for the same. This amount is what it is now costing for street lighting, and the incandescent circuit and the business arc lights will, it is said, pay the operating expenses.

WORTHINGTON, IND.—This town, which has so long been without street lights of any kind at night, has let a contract to the Fort Wayne Electric Light Company for a $12,000 plant, calling for thirty-four arc lights. A $27,000 water-works system was also let to the same company, both to be completed January 1, 1899.

FREDERICK, MD.—James Legore, of Legores Station, this county, is planning to build a monster dam in the Monocacy River, near what is known as the Iron Stone Bridge. The idea is to develop water power for the generation of electricity to be used on the Frederick, Thurmont & Northern Electric Railway. The dam is to be 40 feet high.

PITTSBURG, PA.—Electrical firms throughout the United States and Great Britain are striving to secure the contract for lighting the Vatican with electricity. The contract will embrace the installation of four isolated generating and distributing plants, furnishing power sufficient to illuminate 11,000 rooms. It is not known that the Westinghouse Electric Company has filed a bid for the order, but the belief is that its London agency is in communication with the authorities.

LAS ANIMAS, COL.—The question of granting a twenty years' franchise to J. B. Downing, of Pueblo, to put in an electric light plant in Las Animas was submitted to a vote of the people here, and was voted down by over two to one. Those working against it favor the city putting in its own plant, as it now owns the water works and could do it at a small expense. They say they will pay for one year's lights in advance, which would pay for putting in the plant.

GLENS FALLS, N. Y.—The capitalists who purchased the Kinderhook & Hudson Railroad have bought the Frisby water power at Stuyvesant Falls to run the dynamo which will generate power for the electric cars. The water power cost $125,000. The railroad company will also furnish power for Mr. Frisby's cotton mills.. The fall from the upper dam is 130 feet, and it is proposed to take water from that point through a steel tube. The company also proposes to furnish electric light for the surrounding villages.

HARTFORD, CONN.—T. C. Perkins & Co., this city, have about completed the arrangements for the establishment of an electric lighting plant at Mystic. The plans and specifications have been completed by the engineers, and the contracts for the building and apparatus will be let probably in two or three weeks. The building will be 30x60 feet, of brick and a 150-hp boiler and engine and a 1500-light alternating dynamo will be installed. The company will build with the intention of doubling the size of the plant inside of a year. Besides lighting Mystic, light will be supplied to Stonington and other places and the system will probably be in operation by November 1.

WEST SUPERIOR, WIS.—The City Council has voted to accept the proposition of William Burgess as the basis for a contract for furnishing street lighting to the city. Five bids were received and that of Burgess was the lowest on all kinds of lighting. For three months there has not been a light burning in the whole city, owing to the strained relations betwen it and the water, light and power company. Over $300,000 is represented in the plant of the company. The present company bid $90. Following is the proposition upon which the contract will be based: Five years, for 1200 candle power, 150 arc lamps, $75; 200 arc lamps, $75; 300 arc lamps, $72.50; all lamps over 300, $70; for 2000 candle power, 150 arc lamps, $80; 200 arc lamps, $80; all lamps over 200, $77.50; over 300, $75. Commercial lighting: Arc lamps, 7 o'clock, per month, first, $5, additional, $5; 10 o'clock, per month, six nights per week, $6, additional, $5.50; 12 o'clock, per month, seven nights per week, $7, additional, $6.50; all night, seven nights per week, $8, additional, $7.50. Incandescent lights: Meter rates, 5.10

cents per lamp per hour or 10 cents per 1000 watts; contract rates; running later than 10 o'clock, $50; not later than 12 o'clock, $55; all night, $65; sixteen candle power.

## The Electric Railway.

EAST RADFORD, VA.—The Radford street railway, which has been in the hands of a receiver for several months, has been sold to the Electric Light & Power Company, of Radford, for $3000.

SAN FRANCISCO, CAL.—The Southern Pacific Railway Company has petitioned for authority to substitute electricity for steam in moving its local trains. A large power house will be built. F. S. Douty is secretary.

KANSAS CITY, MO.—The gross earnings of the Metropolitan Street Railroad of Kansas City from June 1 to July 31 were $383,072, against $329,925 last year. The net returns were $164,775, against $148,465 in 1897.

LAWRENCE, KANS.—The City Council of Lawrence granted a twenty-year franchise to the Lawrence Railway Company to build and operate an electric street railway here. The construction of the line is to begin inside of sixty days.

BUFFALO, N. Y.—The Buffalo, Kenmore & Tonawanda Electric road was sold to the bondholders last week under foreclosure of a mortgage held by the Fidelity Trust & Guaranty Company. Spirited bidding brought the price up to $63,147.32. The road cost about $150,000, and the amount due for which it was sold is about $75,000.

CHICAGO, ILL.—Contracts have been let by the Chicago City Railway for the erection of several buildings at Sixtieth Street and Cottage Grove Avenue. There will be two two-story buildings of pressed brick and stone, connected by a veranda, and there will also be a bicycle track, children's pleasure ground and an electric fountain. About $50,000 will be expended.

TERRE HAUTE, IND.—The first mortgage bondholders' committee of the Terre Haute Street Railway Company, of which W. H. Henkle of the Illinois Trust and Savings Bank of Chicago is chairman, has prepared an agreement and has secured the deposit of more than a majority of the bonds under it. The limit of time for receiving deposits at the Illinois Trust and Savings Bank has been fixed at September 15.

WALTHAM, MASS.—It is stated that the Newtonville & Watertown Street Railway Company would like to sell its extension from Watertown to the Watertown Arsenal and to Allston. The Newtonville line now runs from the Watertown Arsenal to Needham, a distance of over 8 miles, and the fare is but 5 cents, and it is claimed the extension to the arsenal does not pay. The line is being further extended across the North Beacon Street bridge to Union Square, Allston.

NEW YORK, N. Y.—Deputy Commissioner Walton, of the Department of Public Buildings, Lighting and Supplies, has declined to issue a permit to the Brooklyn Heights Railroad Company for an overhead trolley line on Montague Street as a substitute for the cable. Mr. Walton says that the necessary consent of the State Railroad Commission had not been secured, and besides he is opposed to overhead trolley wires. He is willing to issue a permit for an underground conduit system.

NEW YORK, N. Y.—Recently Daniel Cortelyou began a suit against the Midland Electric Railroad Company, Staten Island, to recover 5 cents, paid by him, under protest, as an extra fare. This was a test case to determine the right of the Midland Company to charge two fares instead of issuing transfers. The case was decided a few days ago in favor of the plaintiff, Justice Raynaud holding that the company's franchises called for the carrying of passengers from any point on the railroad to any other point, for a single fare.

NEWARK, N. J.—The sale of the Suburban Traction Company, of Orange, has been completed. The road was put up at auction on July 6, and was purchased by the Orange & Passaic Valley Railroad Company. For three and a half years previous to that it had been in the hands of Watson Whittlesey as receiver. The purchasers of the road paid $10,000 down. On August 24 they gave another check for $17,000. Besides that, they assume liabilities of $73,000, which include receiver's certificates and accrued interest. There is $800 due in interest accrued since the transfer was made. Many changes and improvements in the road are in contemplation.

FRANKLIN, MASS.—In The Electrical World of August 20 appeared an item after the date of "Franklin, R. I.," in regard to the probable granting of a franchise to the Milford & Franklin Street Railway Company. It should have been dated Franklin, Mass. This place is a hustling, progressive town 28 miles southwest of Boston, on the main line of the New England Railroad. It is an important manufacturing centre. Insulated copper wire for electric purposes was one of its former industries, which, however, was diverted to Providence by the American Electrical Works. It was an inhabitant of this town who demonstrated to Mr. Charles Williams, of Boston—the original maker of telephones for the Bell Telephone Company—the advantage of using one general return wire for exchange purposes instead of earth connections on the talking circuit for each instrument. It was this same Franklinite, who, by the way, was regarded as a "crank" in his time, who long advocated the benefits to be derived by the use of metallic circuits, and who established the first metallic circuit exchange system in the world.

## Personal Note.

MR. THOMAS. V. HALL, a mechanical and electrical engineer, well-known throughout Missouri, Illinois and Wisconsin, now represents, in Texas, the Fort Wayne Electric Corporation, of Fort Wayne, Ind. Mr. Hall was for several years connected with the Consolidated Engineering Company, of St. Louis, and later with the L. M. Rumsey Company, of the same city, as mechanical and electrical engineer. The Fort Wayne Electric Corporation is fortunate in securing the services of this able gentleman as its representative in an important district.

# Trade and Industrial Notes.

DRY BATTERIES have been found very useful for signal service in the field. The Western Electric Company manufactures the W. E. dry battery, which is said to have a high efficiency and long life, and is admirably adapted for emergencies.

IN THE SPRING of the year the city electrician of Chicago, Mr. Ellicott, installed a small motor-generator outfit to operate the police signal and fire-alarm circuits while the storage batteries were being charged. The Western Electric Company furnished the city with this outfit. The motor-generator was soon put to continuous use to help out the storage batteries, and has been running continuously twenty-four hours a day for over 120 days.

MESSRS. FRANK H. STEWART & CO., 35 West Seventh Street, Philadelphia, Pa., have just issued an attractive catalogue of electric bell, electric gas lighting, telegraph and speaking tube supplies. The catalogue is 8¼x11½ inches in size, is bound in orange cover and is well illustrated. This firm carries, in addition to household electrical supplies, a large and varied stock of electric light supplies. A copy of either or both catalogues may be obtained on application.

TELEPHONES FOR TROLLEY AND OTHER ROADS.—The Viaduct Manufacturing Company, Baltimore, Md., makes from the stump all styles of telephone apparatus, district messenger call boxes and a special trolley outfit—a most useful article. Also a small portable telephone to be carried on street cars where the regular trolley set is not used, connection being made with a telephone wire at the different trolley poles and communication held with the central office.

THE M. C. BULLOCK MANUFACTURING COMPANY, Chicago, Ill., reports that the past sixty days have been a busy period with it. Orders have been received for two central valve engines to be direct coupled to dynamos, one for lighting and the other for power transmission. The company's rock drill business is increasing, a number of Monarch drills having been placed in entirely new fields. The company is preparing its works and force to meet a heavy demand for the various lines of its manufacture.

A CONTROLLING INTEREST in the stock of the Safety Third Rail Electric Company has been purchased by Messrs. Emerson, McMillin & Co., 40 Wall Street, New York, who, after an investigation, have become so convinced of the merits of the system that they will install several miles of road with it as a practical demonstration of its advantages. Captain Murphy, the inventor, will continue his connection with the company. It is understood that the company is making excellent progress. The system will be exhibited at the street railway convention in Boston in the shape of a miniature electric railway, with car one-sixth the regular size.

"ONE-QUARTER OF A MILLION HORSE-POWER of Polyphase Electric Transmission Apparatus" is the title of one of the most atttractive pamphlets the Westinghouse Electric & Manufacturing Company has ever brought out. The volume gives a partial list of Westinghouse polyphase installations, with an explanatory statement that a complete list would require a volume too bulky to circulate in the ordinary way for commercial purposes. It illustrates handsomely various representative and interesting installations, such as the Niagara power plant, the Dolgeville plant, the Canadian Niagara power plant, and various machines, such as the Type C motor, the inductor generator and other types manufactured by the company.

THE ELECTRICAL ENGINEERING COURSE of the American School of Correspondence is, it is stated, supervised by experts in close touch with the latest advances in the science. The instruction is carefully graded, thoroughly practical and scientific, and is intended to give electrical students and engineers a complete electrical training. Among the members of the school's advisory board is Mr. Charles Thom, chief of the quadruplex department of the Western Union Telegraph Company. The school is chartered by the commonwealth of Massachusetts, and is said to be a purely educational institution. It has been warmly indorsed by leading educators and engineers throughout the country. Hand books containing complete information will be sent on application to the school at Boston, Mass.

"PEGAMOID" BRAND LEATHERS.—"Pegamoid" is a liquid composition which, when applied to substances such as cloth, leather, paper, etc., renders them waterproof, besides generally protecting and strengthening the material. It fills the fibres and pores. "Pegamoid" brand leathers are made from cloth or paper, and closely resemble real leather. The advantages claimed for "Pegamoid" brand leathers are durability and that they are waterproof and stain-proof. The surface is firm but flexible, and its wearing qualities are said to be greater than those of leather. It stands extreme heat and cold without change. It may be washed and scrubbed and the surface is not damaged by grease, acids or moisture. These goods are said to be meeting with favor among street railway men for upholstering of cars and other purposes.

MESSRS. SANDERSON & PORTER, contractors for the Meriden & Compounce Electric Railroad Company, have let the contract for furnishing several bridges and buildings on the line of this road to the Berlin Iron Bridge Company, of East Berlin, Conn. The work consists of seven spans of bridges, varying in length from 10 feet to 65 feet; a car barn 50 feet wide and 100 feet long, and a power house 45 feet wide and 75 feet long. The bridges are of steel, and the buildings have steel framework, brick side walls and fireproof roofs. The roof of the power house will be covered with corrugated iron and lined with the Berlin Iron Bridge Company's patent anti-condensation roof lining. This lining, it is stated, has shown itself efficient in preventing condensation and moisture from the underside of covering and doing away with the danger and annoyance of water dripping on the machinery below.

FAN MOTOR OUTFIT FOR TELEPHONE BOOTHS.—The Edison Manufacturing Company, Broadway and Twenty-sixth Street, New York, is making two styles of fan motor outfits for telephone booths. One style is for use on 110-120-volt direct current circuits, and the other for use with battery current. The motor is suspended by a heavy rubber ring from a bracket at-

tached to one of the interior walls of the booth. Connection is easily made by unscrewing the nearest lamp bulb from its socket and inserting the current tap. The lamp bulb must be replaced in the socket of the current tap. The connecting cord leads from the side connections on current tap to the stop-and-start switch on under side of motor. The switch is so arranged that the lighting of the lamp will start the fan. This convenience will no doubt be greatly appreciated, as it will keep the interior of the booth cool and endurable to those who have frequent occasion to shut themselves up in these limited quarters.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York City, state that the call for Whitney instruments is increasing and that the A. E. G. lamp is also meeting with increased demand. These lamps are maintaining their reputation for long life, freedom from blackening and high efficiency. For central station work particularly they are said to be very satisfactory, as they withstand the fluctuating voltages met with in central station practice. A good proof of the excellence of these lamps is a large order received as the result of a competitive test of all the standard lamps, in which the A. E. G. lamps gave the following results: At start, three 110-volt, 14-cp, 2.7-watt lamps; after 400 hours of burning the average candle power was a little under 12 candle power and the efficiency 2.78 watts per candle. The lamps were burned in a horizontal position, and were so continued in use after the completion of the test, having burned 1300 hours at the time of this report. Messrs. Machado & Roller carry a large stock of these lamps, from which prompt shipments can be made.

ENGINE SALES.—Among the recent sales of engines and generators by the Ridgway Dynamo & Engine Company, Ridgway, Pa., are the following: One 18-hp engine direct-connected to a 10-kw generator, for W. H. Brown's Sons, Pittsburg, Pa.; one 30-hp engine, direct connected to a 15-kw generator, for H. H. Stevens, Colorado Springs, Col.; two 250-hp engines to the Berwind-White Coal Mining Company, making seven engines of this size and three 150-kw generators furnished to this concern during the past fifteen months; one 160-hp engine, direct connected to a 110-kw generator, for the Schoen Pressed Steel Company, this being the fourth direct-connected unit furnished the Schoen people; one 40-hp engine, direct connected to a 25-kw generator, and one 80-hp engine, direct connected to a 50-kw generator, for the Collins State Homœopathic Hospital, Collins, N. Y.; two 100-hp engines, direct connected to two 60-kw generators, for the Jefferson Medical College, Philadelphia. Besides these the Ridgway Company has made sales of several engines of 125 and 150 horse-power to go to various parts of the country.

"THE DEVELOPMENT OF THE TELEPHONE" is the title of a handsomely printed pamphlet which the Elkhart Telephone Company, furnishing the independent telephone service in Elkhart, Ind., has recently brought out. The work gives the history of the telephone business in Elkhart, describing the unobliging nature of the Bell Telephone treatment of the public and the growth of the independent system. The latter is forcibly emphasized by a series of illustrations, the first showing a 100-drop board with one attendant, under date of December 1, 1895; the second a 200-drop board, also with one attendant, installed in January, 1896; the third, a 300-line board with two attendants, installed June, 1896; the fourth, a 350-line board with three attendants, installed January, 1897, and the fifth and last, a 600-line board with four attendants, now in service. The company states that the initial expense of the publication is rather out of proportion to local benefits, so that if exchanges now in their formative periods desire copies as aids in their promotion they can secure them by remitting 10 cents per copy to the Elkhart Telephone Company.

THE BOSTON CONVENTION.—The General Electric Company will be well represented at the Boston Convention of the American Street Railway Association, both by engineers and agents, and will have an interesting and novel exhibit at Mechanics Hall. It will establish its headquarters at the Brunswick Hotel, with a reception room on the first floor, whither all delegates are invited and will be made warmly welcome. Advantage will be taken of the fact that Boston is distinctly a General Electric centre to arrange a series of visits to different stations where General Electric apparatus may be seen in commercial operation and to illustrate the history of rapid transit and the actual development of the electric railway. The proximity of the Lynn works of the company will also afford the delegates an opportunity of visiting them and of appreciating the excellence of the methods employed in the construction of railway apparatus. Much new literature will be published by the General Electric press for distribution at the convention, and will be found by delegates at Mechanics Hall and at the company's headquarters. To Mr. W. J. Clark, general manager of the railway department, the interests of the General Electric Company will be confided. He will be assisted by representatives from various sales offices throughout the country.

## Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Fridays of each month, from October 1 to June 1; J. R. Cravath, secretary.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Next meeting, Manhattan Beach, September 13 and 14, 1898.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month, from September 1 to June 1.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Next meeting, Scranton, Pa., September 7-8, 1898.

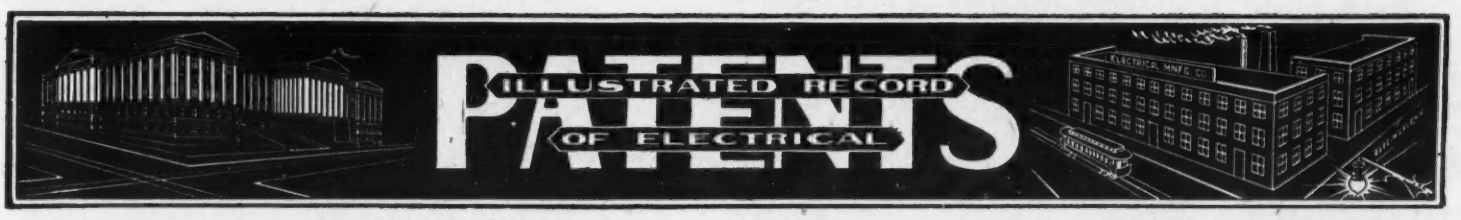
ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

## Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.




UNITED STATES PATENTS ISSUED AUGUST 30, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

609,851. ELECTRIC LOCOMOTION; H. Van Hoevenbergh, of New York, N. Y. App. filed Oct. 10, 1895. A trolley having spring-pressed contacts and conductors connecting with a vehicle, the conductors being mounted on the frame by a laterally movable connection.

609,875. ELECTRODE FOR MEDICAL PURPOSES; M. N. Clarke, of Wilkesbarre, Pa. App. filed Jan. 8, 1898. In an electrical apparatus for medical purposes, a suitable source of electricity and a pair of electrodes, consisting of a suitably shaped metal plates filled with small perforations.

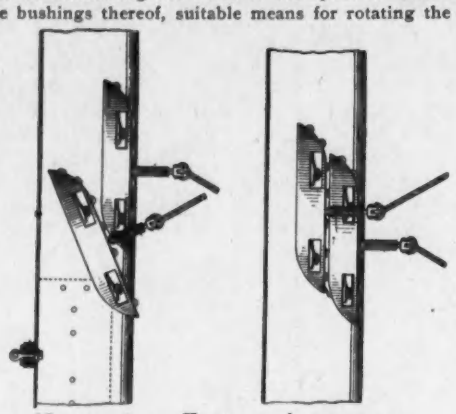
609,877. TENSION REGULATOR FOR ELECTRICAL TRANSMISSION OF SPEECH; A. C. Cousens, of Newark, N. J. App. filed June 15, 1895. The herein described method of transmitting sound, which consists in subjecting to the action of the transmitting current a substance from which is thereby generated a gaseous variable resistance medium, and varying the resistance of said gaseous medium by the action of and to conform to the sound waves to be transmitted.

609,888. CLAMP FOR ELECTRIC WIRES; S. S. Leonard, of Chicago, Ill. App. filed Jan. 24, 1898. A clamp, consisting of a flexible loop adapted to embrace the glass insulator and a pair of clamping blocks loosely secured the loop at one end, and each provided at the other end with a notch adapted to receive the free end of the wire, said free end being provided with means for clamping it upon said blocks.

609,969. TROLLEY; D. Libby, of Mansfield, Ohio. App. filed Feb. 23, 1898. The combination of the pivoted mast a horizontal rod, provided with suitable bearings secured in a post, connections between the mast and the rod, a coil spring surrounding the rod to hold the mast in a vertical position, the said rod being adapted to have a longitudinal movement in the bearings,

the masthead provided with a series of holes radiating from the pivot centre to increase or diminish the leverage upon the spring.

609,972. HANGER FOR ELECTRIC LAMPS; W. F. Murphy, of Iowa City, Ia. App. filed Dec. 21, 1897. In a hanger for electric devices, the combination of bracket arms, metallic spindles connected with and extending inwardly from the bracket arms, and adapted to be electrically conected with the opposite poles of an electric generator, the spool or drum having metallic bushings in its opposite ends snugly receiving the spindles, wires wound on the spool and adapted to be connected with an electrical device, metallic screws connecting the wires to the spool or drum and impinging against the bushings thereof, suitable means for rotating the spool to wind



No. 609,851.—Electric Locomotion.

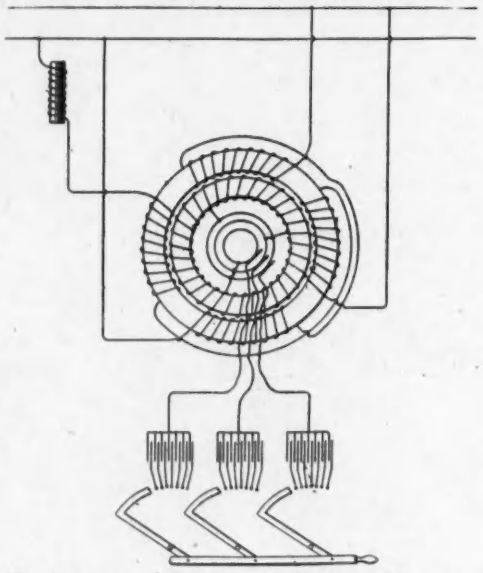
the wires thereon, and suitable means for normally holding the spool against rotation.

609,977. ELECTRIC RAILWAY MOTOR; A. Schmid, of Pittsburg, Pa. App. filed May 10, 1894. In an electric car, a motor sleeved at one end upon the axle of the car, suspension bars secured to said motor above its centre of gravity, springs supporting the ends of said bars, and means whereby said springs are attached to the truck.

609,990. MEANS FOR CONTROLLING NON-SYNCHRONOUS ALTERNATING CURRENT MOTORS; B. G. Lamme, of Pittsburg, Pa. App. filed March 11, 1896. A variable speed, non-synchronous motor having a comparatively large secondary resistance and a small degree of magnetic leakage between its primary and secondary members, in combination with means for varying the e. m. f. applied to its primary member whereby the speed of the motor is varied.

609,991. METHOD OF AND MEANS FOR SECURING CONSTANT TORQUE IN POLYPHASE MOTORS; B. G. Lamme, of Pittsburg, Pa. App. filed Feb. 10, 1898. The method of securing constant torque in an induction alternating current motor, which consists in supplying the actuating currents through choke coils, the magnetic circuits of which become saturated at a predetermined point in the increase of the quantity of current.

610,004. RAIL BOND; William H. Talley, of Waco, Tex. App. filed Nov. 26, 1897. A rail joint, comprising a suitable rail, having a base angle bar located on either side of said rail, and having basal flanges, normally in contact with the base of the rail, angular-shaped grooves formed in the basal



No. 610,025.—Alternating Current Motor.

flanges of the angle bars, and triangular conducting bars located in said grooves and in direct contact with upper surfaces of the base of the rail.

610,007. CONTACT DEVICE FOR ELECTRIC RAILWAYS; L. E. Walkins, of Springfield, Mass. App. filed Jan. 24, 1898. The combination with the axles of electric railway cars, of a shoe supporting frame having suspension supports from said axles, and comprising the articulated supporting member, springs interposed between the top of the frame and a portion of the car or its truck thereabove, a wheel centrally carried by the frame and adapted to run on the top of the third-rail conductor, and a shoe having a depending support from the frame and adapted to bear yieldingly against a sidewise portion of the third rail.

610,008. CONTACT-RAIL APPLIANCE FOR ELECTRIC RAILWAYS; J. E. Walkins, of Springfield, Mass. App. filed Feb. 2, 1898. The combination with the support rail of insulating material, provided at opposite sides with the continuous longitudinally ranging metallic contact conductors, of a double-shoe trolley device, consisting of a depending trolley support having a roller-carrying yoke to run on the top of the support rail, and provided with the oppositely arranged depending inwardly spring-pressed shoes, said trolley support being provided at its upper portion with the paired lateral arms having perforations; and the depending rods or posts downwardly extending through said perforated arms, and the springs.

610,009. ELECTRIC RAILWAY; L. E. Walkins, of Springfield, Mass. App. filed Feb. 2, 1898. In an electric railway system, the combination with a longitudinally ranging series of transversely axial roller wheels horizontally arranged, each having a central rim, and at either side thereof an annular section of metal insulated from the central rim, and each of said annular sections having a surrounding collar in contact therewith, of means for preventing the rotation of the collar, line and return wires and electrical connections between said wires and said collars.

610,023. AUTOMATIC CUT OUT FOR MAGNETO-GENERATORS; W. J. Bowen and Charles A. Federer, of Cleveland, Ohio. App. filed May 26, 1898. In an automatic cut out, a rotatory spindle having a projection of insulating material provided with a recess, a loosely mounted wheel connected with the generator and having a pin resting within the recess of the projection, a contact plate in the recess and a spring arranged to normally hold the plate and pin in contact.

610,025. ALTERNATING CURRENT MOTOR; C. S. Bradley, of Avon, N. Y. App. filed Sept. 17, 1897. An electric motor having a primary winding provided with a plurality of branches, one or more of which includes inductance to set up in the primary core a rotary field when connection is made with a single-phase current, and a secondary element, the winding of which is connected with an adjustable phase-leading device.

610,064. CONTROLLING DEVICE; K. A. B. D. Kottgen, of Charlottenburg, Germany. App. filed Dec. 30, 1897. The combination in a controlling device with a plate provided with a branched guiding slot, of a laterally movable slotted controller part, a controlling lever extending through said slotted parts, a mounting therefor adapted to permit the composite movement of said lever, and connecting parts uniting the controlling lever and part with the controlled machinery.

610,067. INDUCTION MOTOR; B. G. Lamme, of Pittsburg, Pa. App. filed July 22, 1897. In an alternating current induction motor, a secondary member, comprising a spider, a laminated, slotted core, bar conductors located in the core slots and projecting beyond the ends of the same, and resistance rings provided with ventilating and centreing blades, which are bolted to the inner sides of the projecting ends of the bar conductors, and having shoulders bearing against the adjacent portion of the spider.

610,090. ELECTRIC RAILROAD; B. C. Seaton, of St. Louis, Mo. App. filed April 5, 1897. In an electric railroad, the combination of the cross pieces, the insulating support and housing, the clamping and fastening devices and the conductor.

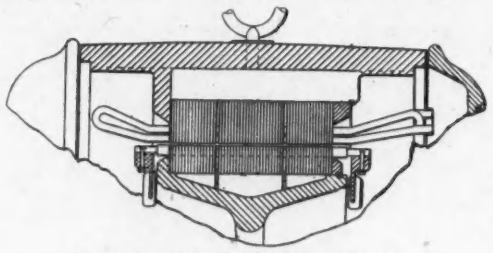
610,091. THIRD RAIL FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Dec. 7, 1897. In an electric railway, a third rail formed with a channel in the upper side to receive feed-in wires.

610,092. CONTACT DEVICE FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 4, 1898. In a contact device for electric railways, a supporting bar, a hanger having a slot and pin connection with the bar, a bracket against which the hanger bears, a spring forcing the hanger against the bracket, and a shoe secured to the lower end of the hanger.

610,093. THIRD RAIL FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 4, 1898. In a third rail for electric railways, a conductor having a vertical flange providing an exposed surface for the contact shoes and a lateral flange, providing a guard for the contact shoes.

610,094. ELECTRIC RAILWAY; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 18, 1898. In an electric railway, a third rail in combination with a crossing located in a gap in the third rail and consisting of a hood, bars supporting the hood and a conduit inclosed by the hood and bars.

610,124. CONTROLLER FOR ELECTRIC MOTORS; H. P. Davis, of Pittsburg, Pa. App. filed April 25, 1898. In a controller for electric motors, the



No. 610,067.—Induction Motor.

combination with a resistance varying switch and a series parallel switch, the shafts of said switches being at right angles to each other, of gearing between said shafts, combined cut out and reversing switches and interlocking mechanism.

11,689. ELECTRIC CIRCUIT CONTROLLER; J. H. Bowley, of Washington, D. C. App. filed March 19, 1898. An automatic regulator for electric circuits, consisting of a receptacle having a base and neck portion, said neck having an upper and lower compartment, a float mounted in the lower compartment of the neck, a standard erected upon said float and in said neck and having fingers designed to engage the ends of the wires forming the circuit.